Materials & Methods

Special Report

June
1953

New Demands Lead to New Directions in Engineering Materials

Materials Show Preview

Materials Exposition Directory and Conference Program

THE MAGAZINE OF
MATERIALS ENGINEERING
DEVOTED TO THE MATERIALS PROBLEMS OF PRODUCT DESIGN AND MANUFACTURE

superfine finish eliminated buffing on these parts

For the temple bow illustrated, Sunware Products Inc., New Britain, Connecticut, makers of Rayex Sun Glasses, formerly used ordinary drawing brass and finished this part by hand buffing—one at a time.

This was a costly procedure, so a switch was made to Formbrite* . . . then a happy thought occurred:

With Formbrite's superfine grain structure and added surface hardness, why not *tumble* these bows—by the thousands.

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Formbrite, just in case you haven't heard, is a superior drawing brass. Comparative tests prove conclusively that the superfine grain structure of this specially processed forming brass means stamped and formed products that are stronger, harder, "springier" and more scratch-resistant. Yet the metal is so ductile that it can be readily formed, drawn and embossed.

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Another new development using

B. F. Goodrich Chemical *raw materials*

Bellows for Piasecki HUP helicopter molded by Surgical Rubber Co., Norristown, Pa. B. F. Goodrich Chemical Company supplies the Hycar rubber only.

'copter crews like Hycar "umbrella"!

LIFE at sea isn't always smooth-going for these HUP helicopters. They operate under all sorts of weather and service conditions—must have unique parts and devices to help keep 'em flying efficiently.

One of these important devices is a rotor spinner bellows made of Hycar rubber. It operates with the propeller pitch control link—flexes and twists as the rotor blade angles change—shields the rotor head controls from rain and salt spray. Acts like an umbrella!

Naturally, Hycar rubber is an ideal material for a job like this. For Hycar has great resiliency and strength, plus extreme resistance to heat and cold, aging, abrasion, gas, oil and many chemicals. In this bellows, Hycar meets military specifications MIL-R-6855, Class I and II.

One of the many Hycar rubber compounds may answer a problem for you—help you develop or improve more saleable products. For information, please write Dept. HR-3, B. F. Goodrich Chemical Co., Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

The Materials Outlook

A new silicone elastomer with exceptional electrical and high temperature properties has been developed. It has a dielectric strength of 120 to 1400 volts per mil and a power factor of 0.0072. The new compound has held up for more than 200 hr at a temperature of 600 F. Current temperature limit of silicones for long-time operation is about 480 F. Water absorption is reported as 1% after 24-hr immersion at room temperature.

New alloys of unknown composition developed by the Swiss have increased the life of the reactor lining in an important chemical process from 1 yr to 10 to 15 yr. Lead or silver was formerly used. These alloys have also replaced stainless steel in an expansion valve which now lasts 1½ to 2 yr instead of 6 to 12 weeks. The process is the production of urea and involves an atmosphere of carbon dioxide and ammonia at temperatures of 360 to 390 F and pressures of 180 to 200 atmospheres.

Some attention is being given to the possibility of using thin high-strength plastics films bonded to metal surfaces for corrosion protection in lieu of coating systems. Good surface preparation would still be needed, but the film could be applied in one operation and, since it would cover all projections, in much less thickness. Hence, both material and labor costs would be lower.

Magnesium-lithium-aluminum alloys being developed by the Bureau of Mines are said to show much promise as structural materials.

Broadened applications for versatile polyethylene can be expected in the next three years. Molders already drastically short on this plastic have hesitated to try new uses. Current expansion by the two producers, now making about 125 million lb a year, will do little more than catch up with pressing demand. But, in the last couple months, two more chemical companies have announced they will enter the field in the Spring of 1955 with a total initial capacity of 110 million lb. Others may follow.

Some powder metallurgy people think sintered aluminum powder (SAP), despite its good high temperature properties, will have only limited application. They point mainly to the cost of raw materials. The dry flake pigment costs three times as much as aluminum pig. In contrast, they say, the granular powder used in conventional powder metallurgy methods costs only 50% more than aluminum pig. However, the problem of suitable lubrication in conventional processing has yet to be solved.

Attempts are being made to develop bi-metallic tubing for use in high tem-

(Continued on page 4)

The Materials Outlook *(continued)*

perature heat transfer. Inner part would be highly corrosion resistant and outer part would back it up with required strength. Bi-metallic tubing now available is not integrally bonded; different coefficents of expansion pull layers apart at high temperatures, causing poor heat transfer.

A radioactive material which emits enough light to read by in pitch darkness but gives off no harmful gamma rays is being used for personnel markers by the Navy. The material, known as Strontium 90, glows with various colors, depending on the impurities in the zinc base from which it is made.

A good bet to take over a large share of the high-grade mica market is a flexible paper-like material made from scrap mica. It does the same job, but is much more flexible and easy to handle; is much more uniform, allowing thinner sections to be used; and costs about 70% less. . . . A sheet mica stronger and denser than natural mica is being produced by combining flakes of two synthetic micas of different compositions. It is said to be superior to natural mica at elevated temperatures in its insulating qualities and outgassing characteristics.

Highly alloyed vanadium is reported to have equalled molybdenum in high temperature tensile strength, and work is being done on the elopme of ternary alloys which would raise the maximum service temperature to 1650 F. Although there has been much question as to whether vanadium will find any widespread use, some who are studying it feel that it will find a niche where operating temperatures are in the 1300 to 1650 F range. . . . A vanadium producer sees possible use for vanadium in electrical applications since its electrical resistivty varies linearly with temperature.

The recent flurry of publicity of the possibilities of reinforced plastics for airframes has produced mixed reactions. Many engineers feel that such materials can never stand up under the stresses produced in high-speed aircraft. But others are more optimistic, and several aircraft manufacturers are known to be seriously investigating this field. . . . One type of construction which may replace balsa and sandwich materials is foam plastics with an outside layer of reinforced plastics. The foam is lighter, easier to fabricate, and just as strong; main problem is to get temperature limit raised from 300 up to 500 F.

Although a good deal of the work on high temperature materials for jet use has narrowed down to finding a way to protect molybdenum from oxidation, some engineers are beginning to say that this trick just can't be done. Even with the best coatings, such as nickel-chromium alloy, it takes less than a pinhole to start the volatilization that won't stop until the metal is completely gone. They question the value of any material whose surface protection is that critical.

Adhesive bonding of aluminum alloy parts in aircraft is getting more serious attention in this country. Resin binders of the epoxy type have been used for several years by the British. Joints stronger than riveted joints have been made, and the lack of rivets and welds gives a smooth surface much to be desired in high-speed flight.

56-Hour Work Week a Year

. . . Incoloy retort still going strong at temperatures up to 2050°

Here you see a long life Incoloy hydrogen annealing retort going into the furnace at L. & R.'s shop where it will soak at 2050° F. for 4 hours, then be gradually cooled to room temperature. It was fabricated by the NEWARK METAL PRODUCTS CO., Kenilworth, N. J., from 1100 pounds of Incoloy.

Latest reports on Incoloy®, new companion alloy to Inconel®, include some remarkable service records.

As a hydrogen annealing retort, for instance.

Here—where other metals failed quickly, some in as little as 42 hours — Incoloy has already given over 3,000 hours of service. And it's still going strong.

This Incoloy annealing retort is being used by L. & R. HEAT TREATING COMPANY in Newark, N. J., for heat treating T.V. shields, hearing aid components, and laminators for servo-motors.

What an ordeal this retort goes through!

First, after being loaded, the retort is soaked at 2050° F. for 4 hours. Then the temperature is reduced 100° F. hourly until the retort reaches 1200°F. It is held there an hour and then allowed to cool to room temperature. *A total heat of 14 hours.* And it has to go through this grind four times a week!

L. & R.'s Incoloy retort has been in service a year now and it's still in shape for more of the same.

L. & R., incidentally, was voted a "best shop" commendation by members of the Metal Treating Institute.Their engineers, still watching Incoloy's record, already say service has been "very satisfactory."

The fabricators of the Incoloy retort, NEWARK METAL PRODUCTS CO., Kenilworth, N. J., found that this new member of the Inco family was readily fabricated into heat treating equipment of all types. It is both workable and weldable for maximum flexibility in efficient design.

If you would like to learn more about Incoloy, write for your copy of "Preliminary Report on Incoloy."

It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill. The International Nickel Company, Inc., 67 Wall Street, New York 5, New York.

Inco Nickel Alloys

INCO TRADE MARK

Incoloy . . . *for Heat-Resisting Applications*

Eight Symposiums Scheduled for ASTM Annual Meeting

To Be Held June 28-July 3 at Atlantic City

The 56th annual meeting of the American Society for Testing Materials will be held June 28 to July 3 at the Chalfonte-Haddon Hall, Atlantic City, N. J.

Eight technical symposiums and many other technical papers covering a wide range of engineering materials are on the program. The symposiums include one on Metallic Materials at Low Temperatures and one on Porcelain Enamels and Ceramic Coatings as Engineering Materials. Other symposium subjects are Techniques for Electron Microscopy, X-Ray Spectrographic Analysis, Radioactivity in ASTM Work, and Significance of Tests of Concrete.

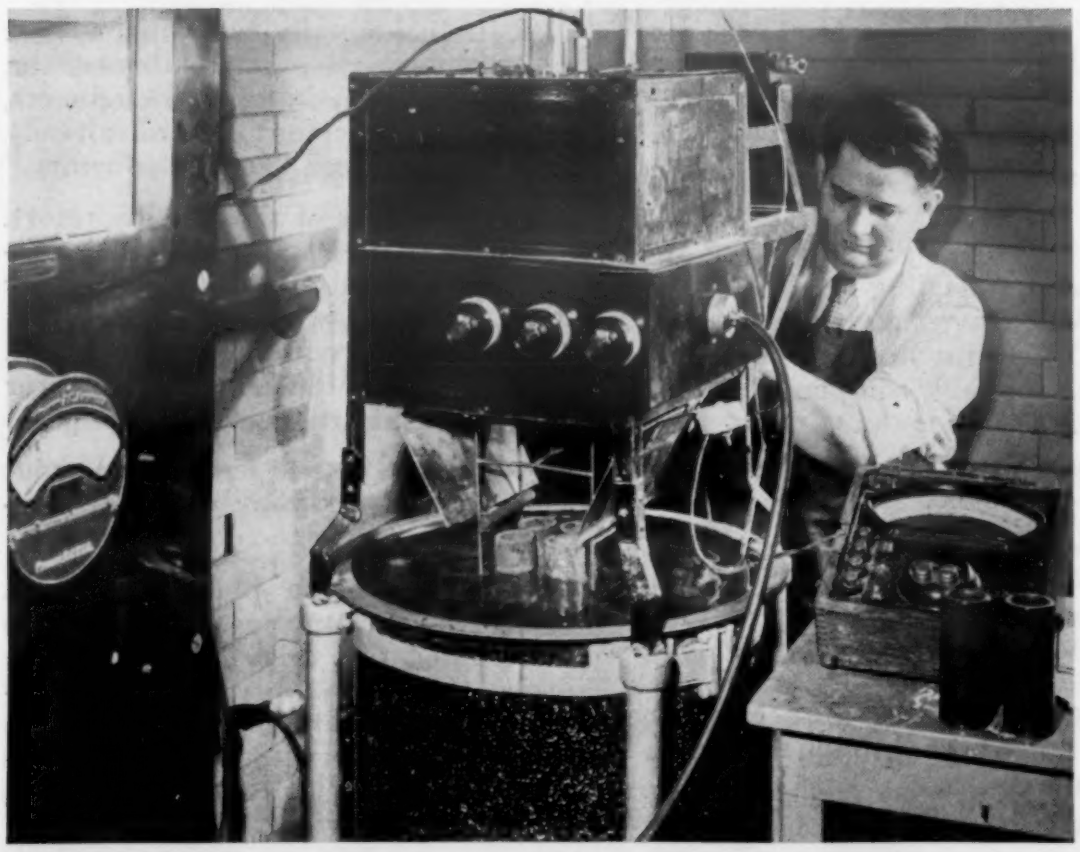
The second H. W. Gillett Memorial Lecture will be delivered Tuesday afternoon, June 30, by Jerome Strauss, Vice President, Vanadium Corp. of America, on "Micrometallurgy." The 27th Edgar Marburg Lecture will be given Wednesday afternoon, July 1, by Frederick D. Rossini, Director of the American Petroleum Institute Research Laboratory, on "An Excursion in Petroleum Chemistry".

Another highlight of the program will be the official luncheon session set for Tuesday noon, June 30, when ASTM President H. L. Maxwell will give the annual President's Address. Awards of merit will be presented; 40- and 50-year members recognized; and other honors awarded.

Beginning Sunday, June 28, and extending throughout the week there will be an estimated 600 meetings of the various ASTM technical committees. In addition to the symposiums and groups of technical papers, there will be a number of round-table discussions as well as informal sessions.

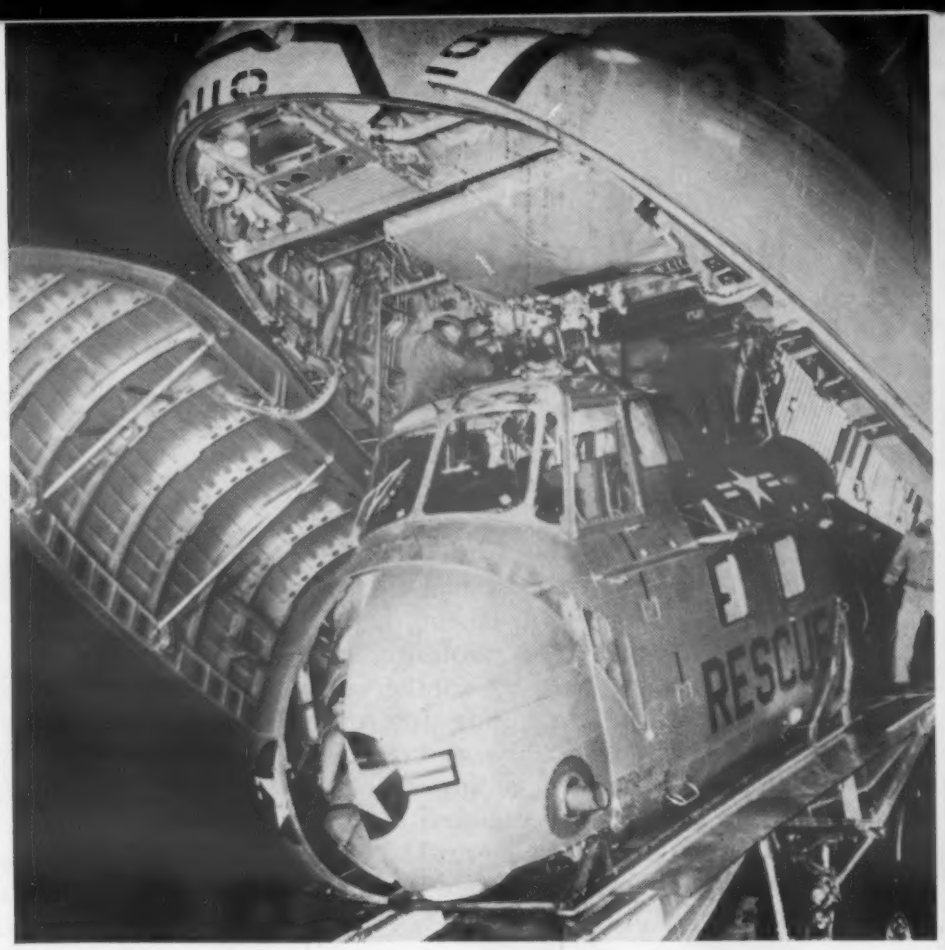
Among the subjects to be covered in the symposium on Metallic Materials at Low Temperatures are: brittle failures in ship plates; theory and significance of brittle fracture; evaluation of impact tests; and the low temperature properties of titanium, steels, iron, stainless steel, nickel cast iron and ductile cast iron.

The symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials will cover: resistance to weathering; acid resistance; aircraft applications; abrasion resistance; electrical resistivity; and the strengthening effect of porcelain enamel on sheet iron.



Glassed-Steel Gets Shock **New glass formulations for glassed-steel are tested for thermal shock resistance in the recently expanded research center of Pfaudler Co. Sample glassed-steel cylinders, heated to high temperatures, are dunked in water at 55 F. Then they are dusted with a white chalk and examined for cracks.**

Vibration of aircraft components is studied in this 40-ft "shaker", only one of its kind, by engineers of Bell Aircraft Corp. The tower can subject parts weighing up to 3000 lb to vibration frequencies of from one to 15 cycles per sec and amplitudes up to 5 ft. Thus, this unique structure simulates buffeting of aircraft at high speeds.



Magnesium plays a big role in the Sikorsky S-55 helicopter. It is fabricated almost entirely from magnesium sheet and has 100 magnesium castings. Here it has been stripped and is being swallowed up by C-118 Globemaster, which will ferry it to the Korean theater of operations. (Courtesy The Magnesium Assn.)

Zirconium Made by Arc Method

A new continuous method for producing zirconium was announced recently by the National Research Corp., Cambridge, Mass.

The new process involves arc dissociation of halides. A paper on the subject was given by James H. Moore, Director of NRC's Metallurgical Dept., at the Electronics Div. spring meeting of the Electrochemical Society. The information presented was only recently released from security restrictions by the Atomic Energy Commission.

Officials of National Research Corp. have pointed out that while the process described may be commercially interesting for production of special grades of titanium and zirconium, it should not be considered a satisfactory answer to the major problem of finding a cheap method for tonnage production of these metals. NRC, in partnership with Monsanto Chemical Co., is engaged in an intensive study of this latter problem.

Plastics Moldings Will Get Still Larger

Now Making 60-Lb Housings

Larger and larger one-piece molded housings for furniture, home appliances and office machines is a major aim of the plastics industry.

Several weeks ago an estimated 150 industrialists, designers and plastics industry representatives got together in New York City for the first Joint Conference on Design in Large Thermosetting Plastics Moldings. The meeting was sponsored by the Society of Industrial Designers and SPI's Committee on Large Plastics Moldings.

The conference was restricted to large-size high-production items die-molded of phenolic, urea and melamine plastics in high-compression presses. Current successful applications include radio and television cabinets, air conditioner housings, furniture drawers and office machine housings.

The conference agreed that new techniques make possible strong molded housings weighing up to 60 lb. The appeal of such moldings seemed to be based on these inherent features:

1. Design of the housing can be functional.
2. They won't scratch. Color goes all the way through the material, or it can be painted or metallized.
3. They are strong, yet light in weight.
4. Despite light weight, they have

(*Continued on page 8*)

the appearance of solidity.

5. They can't rust. They resist burns, alcohol and other staining liquids.

6. They can be made to blend with modern home or office decor.

Continuing improvements in both phenolic and urea molding compounds were cited as another indication of the expanding future for large moldings. A new urea with greatly improved molding characteristics that was announced recently is expected to extend greatly present size limits on light colored moldings.

Plastics Show

The sixth National Plastics Exposition will be held the week of June 6, 1954 at Cleveland, Ohio in the Cleveland Auditorium.

The show is sponsored by The Society of the Plastics Industry, Inc. Harry Grunnagle of Westinghouse Electric Corp. is chairman of the committee for the show.

Powder Metallurgy Presents Record Show

Looks to Civilian Applications

The powder metallurgy industry is still growing rapidly, if attendance at the annual Metal Powder Shows may be taken as any criterion of its state of health. Nearly 800 attended the technical sessions and exhibits in Cleveland, late in April. This represents an increase of about 30% over last year and is in keeping with the steady growth experienced since the inception of the meetings nine years ago.

In contrast to last year, when uncertainty of the future was very much in evidence, optimism ran high. From all reports the industry is prosperous, and the future looks bright. Apparently, metal powder producers and parts fabricators have finally convinced themselves that the industry can advance with or without iron powder rotating bands and ammunition.

The nature of the technical papers indicated also that the industry is no longer preoccupied with defense applications but is again turning to peace time uses. Whereas last year three papers were related to military applications, none of the papers presented this year had a bearing on this subject.

High Strength Sinterings

A most significant trend in the powder metallurgy field today is the processing of iron powder parts in the higher density ranges. Evidence of this trend was given by W. J. Doelker and H. T. Harrison in their paper describing the production of high strength precision iron powder sinterings at the National Cash Register Co.

Production of parts for business machines made by National Cash Register Co. began about 15 years ago, but the tools and powder then available were not suited for production of high density parts. However, an investigative program continued. "The first break came", said Mr. Doelker, "with the availability of a high quality electrolytic powder that was within a reasonable price range".

They found that by pressing electrolytic powders under pressures of from 100,000 to 120,000 psi, relatively high density parts, from about 7.20 to 7.40 gm per cc, could be produced, and, after sizing, the density could be increased to over 7.60 gm per cc. The use of such pressures to produce parts on a production basis introduced a problem of tool life. But by adopting carbide tools and dies this problem was solved.

"From this beginning", said Mr. Doelker, "we have progressed to the point where we have more than 90 parts in production and more than that number of parts in the process of being tooled up for production. We are now producing, on an average, over 700,000 parts per week". He said the development of pow-

(*Continued on page 11*)

What They Said. . . . .

LEAD-CLAD STEEL "Where space is no problem, nucleur researchers could use immensely thick walls of concrete, but confronted by the problems of how to house radioactive materials where every fraction of an inch of space is vitally important, the use of concrete is often impossible. Lead-clad steel combines the all important element of protection with the strength of steel."—Alfred P. Knapp, President, Knapp Mills Inc., Feb. 8, 1953.

PROCESS RESEARCH "To enable the nation's industry to produce goods at low cost, to accurate standards, and in the quantities necessary to make our defenses secure, the United States must spend more time and money in researching manufacturing processes. . . . The ultimate rewards of processing research are generally far greater than the costs involved, however large the investment may seem to be in the beginning."—*Roy T. Hurley, chairman and president, Curtiss-Wright Corp., Apr. 20, 1953.*

CORROSION The steels used for automobile bodies are not selected with resistance to corrosion as a major consideration. In fact, emphasis on low cost . . . and fabrication qualities tends to favor compositions of steel that may approach a minimum rather than maximum resistance to atmospheric corrosion."—F. L. LaQue, The International Nickel Co., Inc., Mar. 3, 1953.

PLASTICS "The greatest single need today is a speed-up in the development of plastic fabrication techniques."—Dr. Frank K. Schoenfeld, Vice President, B. F. Goodrich Chemical Co., Mar. 11, 1953.

News Digest

continued from page 8

der metallurgy had provided the National Cash Register Co. with an opportunity to produce high quality, high strength parts in large quantities and with accompanying large reductions in both production and tool costs. Mr. Doelker added that "we have found that we can produce parts at higher production rates within very close dimensional tolerances and we have found that some parts produced by this method are actually stronger than those same parts made previously from steel bar and strip. Surface finishes can be held, especially on peripheral areas, to a micro-inch finish comparable or better than ground surfaces. Scrap losses have been held to a minimum and losses in the neighborhood of only 2 or 3 parts in 3 million are not unusual, and these are due almost exclusively to breakage during handling".

Mr. Doelker brought out that the development of powder metallurgy has provided them with a highly economical, high production method of producing superior quality parts and that the management and production personnel of the National Cash Register Co. are thoroughly convinced of its usefulness and are employing it over a wider and wider variety of parts, stimulating its growth and urging the development of more and broader ranges of application.

Aluminum Powder

Periodically, interest in the potentialities of aluminum powders for structural parts is revived. The most recent revival has been generated by the announcement in this country of sintered aluminum powder (SAP), developed in Europe during the past five years.

John Haertlein and J. F. Sachse, Metals Disintegrating Co., Inc., in their review of recent developments in aluminum powder metallurgy indicated that applications of SAP will be decidedly limited largely because of its high costs. "The raw material from which SAP begins", said Mr. Haertlein, "is the finest grade of dry flake aluminum which sells for something like three times as much as aluminum pig." The raw material from which conventional aluminum powders is produced", he

(*Continued on page 256*)

unique

AGITATOR DESIGN

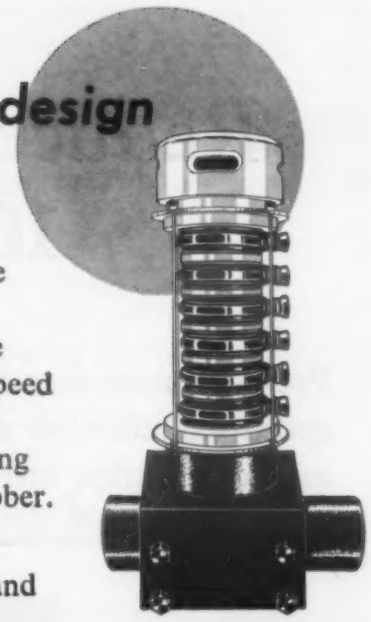
...another example of good design

***with* ACE® HARD RUBBER**

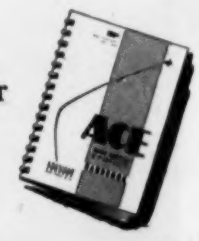
By rapidly removing spent plating solution from the surface being plated and continuously replacing it with live, up-to-formula solution, this impressive "Speed-O-Plate" Agitator makes possible amazing speed in lead coating aircraft bearings. Alsop Engineering Corporation licked the corrosion problem by making this model "Speed-O-Plate" entirely of Ace hard rubber.

Blocks, cylindrical sections, bolts and nuts are all machined from Ace sheet, pipe or rod. Agitators and spray heads are molded. Steel shafts are covered with tubing. Even the motor couplings use hard rubber – for electrical insulation.

In your work, too, you'll often find the properties you're looking for in one of the many Ace hard rubber and plastic compounds. These properties – together with page after page of design hints for mechanical, electrical and chemical parts – are covered in the new Ace Handbook. Keep it always under your thumb. If you haven't a copy, write today.



View of plating station. Six bearings are positioned in hard rubber "stacks" mounted on plating head.



ACE rubber and plastic products

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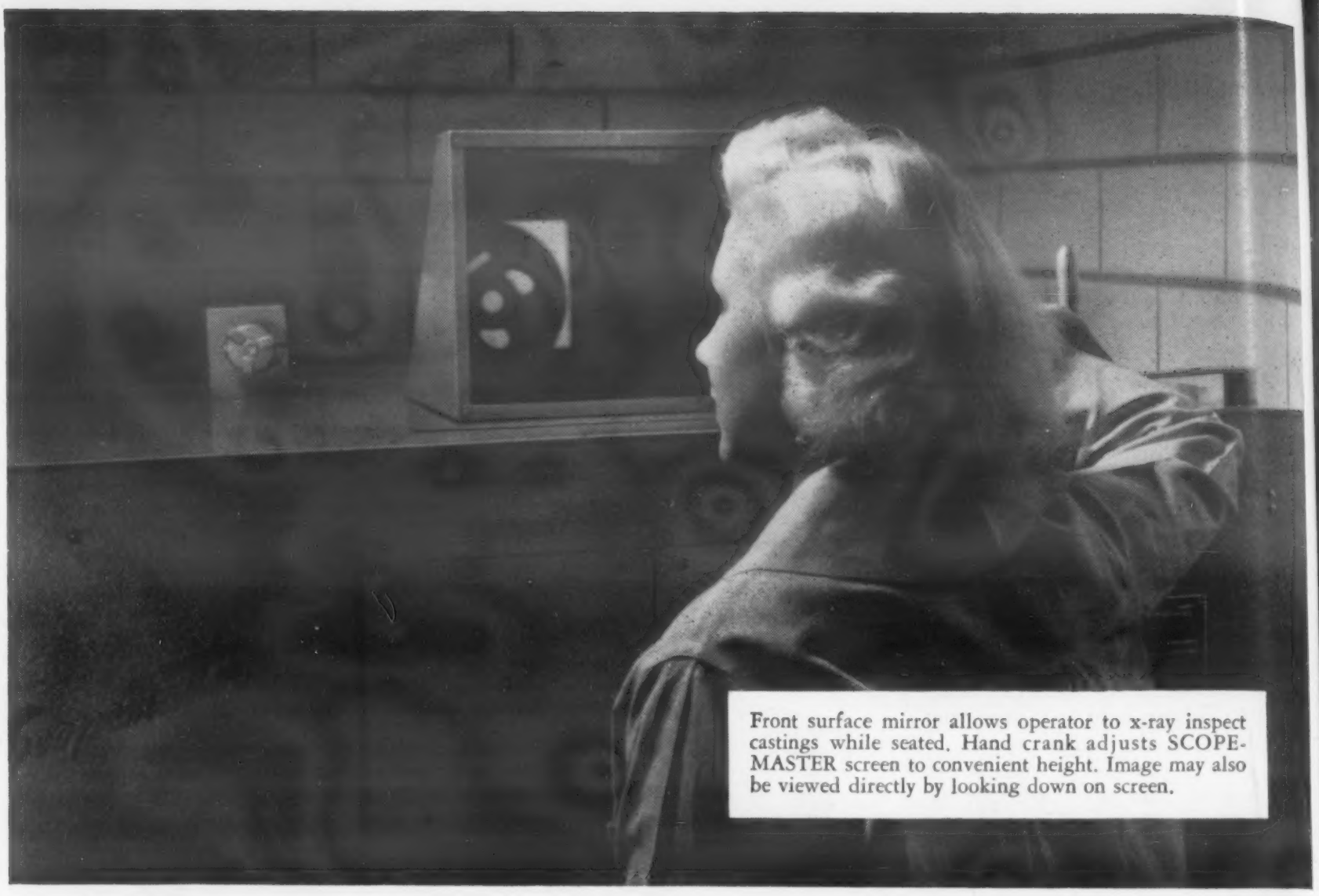
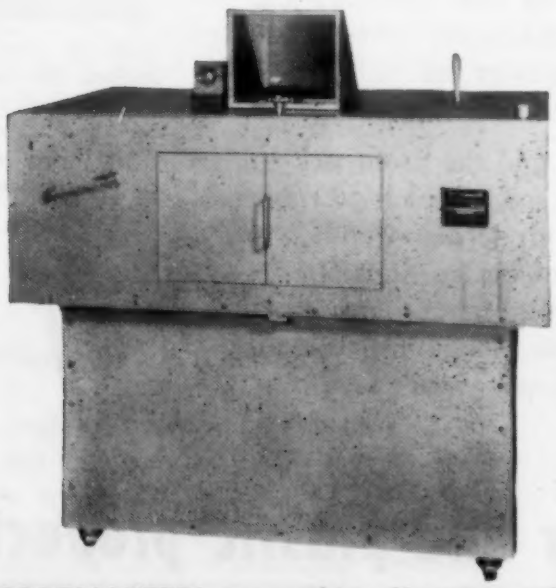


Front surface mirror allows operator to x-ray inspect castings while seated. Hand crank adjusts SCOPE-MASTER screen to convenient height. Image may also be viewed directly by looking down on screen.

Reduce costs! Use GE Scopemaster for 100% visual x-ray inspection

Provides more than ample sensitivity in high-speed examination of light-metal castings, molded plastics, intricate assemblies, etc.



SCOPEMASTER's screen-object distance can be varied to magnify image, and a single control moves the sample longitudinally or transversely. Unit is fully protected for stray radiation.

100% fluoroscopic x-ray inspection can prove a valuable tool in your plant. Pioneered for the aircraft industry, the GE SCOPEMASTER saves producers and users of light metal alloy castings time and money in catching defective parts. The accuracy of its inspection is attested by its use on airframe castings where failure could cause a serious accident. It is vastly superior to sample inspection by other means, and costs are far lower than with any other method of comparable thoroughness.

Other jobs on which x-ray fluoroscopy has been successful include checking small electrical components for incomplete or improper assembly. In the molded plastics industry, it has helped establish manufacturing technics. And in the production of small ordnance items, it replaced destructive spot tests — salvaged 90 to 98% of lots that previously would have been rejected in their entirety.

The SCOPEMASTER is another example of how General Electric is harnessing x-ray to the needs of industry. If there's a testing or inspection trouble spot in your plant, x-ray may be the answer. Ask your GE x-ray representative for an evaluation, or write your requirements to X-Ray Department, General Electric Company, Milwaukee 1, Wisconsin, Rm. AZ-6.

GENERAL ELECTRIC

New Demands

Lead to

New Directions

In Engineering Materials

The Demands

There are but few products being made today that could not be made better; that is, they could be made better if the necessary materials were available from which to make them. Although we have made much progress in engineering materials up to the present time, we are going to be asked to exceed this progress by many times within the next few years.

There is a constant race between the properties being developed in materials and the demands being imposed on materials. For example, we develop materials that meet all requirements for temperatures of 1200 F, and immediately the temperature goals are raised to 1800 or 2000 F. Presently there must be a compromise between what engineers want to do and what the materials they have to select from are capable of doing.

There is hardly an industry operating today that could not put some new or better materials to use immediately. Some of their problems are urgent, others are clearly enough defined to indicate that they, too, will be urgent before very long. Some of the answers will be found in entirely new materials, but more will be found by improving our basic materials, by learning more about them, and by learning how to use them better.

Although no industry is immune from the constant search for better engineering materials, certain fields have objectives that are distinct and more easily defined than do others. These objectives, even though understood and recognized, are going to be difficult to achieve unless we are able to find materials to meet extremely stringent operating conditions. Focal points in the demand for better materials are:

Atomic Energy—It is doubtful that anyone could list even the majority of needs in the field of materials which confront those dealing with atomic energy. Foremost on the list, however, would be the materials needed for reactor development, or for the ultimate utilization of atomic energy for civilian uses.

Chemical Processing—There is a definite trend in the process industries towards higher and lower reaction temperatures. With the higher temperatures come the needs for stronger materials to withstand corrosion, high temperatures and high pressures. At the other extreme, there is a need for materials that are not subject to low temperature embrittlement. As we enter what appears to be a chemical age, problems of this nature are likely to be more frequent and more complex.

Power Generation—The vastly increased use of electrical energy makes imperative the development of more efficient generating equipment. Where steam is the source of generated electricity, efficiency is anticipated through higher steam pressures. To withstand high steam pressures and the accompanying high temperatures, steam turbines will have to be built of stronger materials. In addition to being strong and temperature resistant, the materials must have high creep strength and be capable of surviving the erosive action of high pressure steam. What's more, these properties must be constant for long periods of time.

Transportation—There is a frantic urge in all transportation fields towards greater speed. With the exception of military aircraft, there is the twin demand for greater economy of operation and greater comfort for operators and passengers. Stronger materials are needed to permit lightweight construction. Naturally, the major materials problems surround the development of faster and more powerful jet engines. Many of the lessons learned in jet aviation will soon filter down to other forms of transportation as well as to other industries whose problems are parallel.

Although the materials needs of these industries have been dramatized more than like problems in other industries, the problems in these industries are no less real. Home appliances need better thermal insulation and smaller and more efficient electrical equipment. All industries could use inexpensive, easily formed materials that are highly resistant to corrosion. The silverware industry would like tarnish-proof silver and silver-plate. The list is endless.

Two Types of Problems

Basically, there are two types of problems which must be faced today, or in the very near future. Some of these problems are fundamental and can apply to most materials. Others are more specific. In the case of the first type, many of the answers will come only through basic research. When that has been completed, it is more likely that the second category will be answered most satisfactorily.

In addition to the desire to get materials that will be capable of meeting new and difficult service requirements, there is one other important impetus towards better materials. Cost is an ever present concern in most engineering departments. As most costs go up, there is an added reason to reexamine lower cost materials to see if, through better en-

Needed. . . .

"A higher magnetic saturating type of material with quality similar to a ferrite."

gineering treatments, they can take the place of more expensive materials.

Finally, we are going to have to learn to do without some of the alloying elements responsible for many of the favorable properties to be found in today's engineering materials. Even if our engineering problems were not becoming more stringent, we would soon find it necessary to develop new materials that were free of strategic elements or to learn how to live with the materials that are plentiful.

The Fundamental Problems

During most of our industrial history, research in connection with engineering materials has been concentrated on specific problems. When we needed a better material we experimented until it was found. Recently, more and more research workers are coming to the realization that while applied research must continue, there are certain problems which can only be answered after some basic information has been developed.

We know that certain materials will behave in certain ways under certain circumstances. Until we know why they behave as they do, any progress that we make in improving properties will be more or less accidental.

The classic example of our lack of knowledge is the case of iron. Never, to our knowledge, has absolutely pure iron been made. It is believed that even minute traces of impurities in iron have a profound effect upon its properties. So one big objective is to determine the properties of pure iron. When those properties are known, it will be much easier to produce tailor-made properties in irons and steels. It is expected that the path of research will lead back to a study of a single iron crystal. Some basic research has already been done with iron. Among interesting facts learned through early research is that at extremely low temperatures iron is an excellent conductor of electricity.

Similar studies will be made of other elements that are used as engineering materials or as alloying elements. When a complete library of properties of all elements is completed, it might be possible to compound materials for any given applications according to a prescription.

Today we know practically nothing about the fundamentals of fatigue resistance, impact strength or notch sensitivity. We only know that some of our materials possess these properties and that others do not. We must know why.

Several industries need metals that are absolutely pure. However, the need is greatest in the atomic energy and electronic fields. Further research is needed to learn how to eliminate impurities during production of metals and to prevent unwanted contamination during subsequent working and treating.

In atomic energy, pure materials are essential because any impurities that appear in the basic metal might become radioactive. To illustrate, AEC spokesmen cite the presence of cobalt in stainless steel. Cobalt 60 has a long half life, retaining its radioactivity for many years. When and if cobalt, which is usually reported as part of the nickel content of stainless steels, is present in the stainlesses used in building reactors, it could create serious problems in building and repairing reactors. Because of the danger involved, AEC officials are considering writing into their specifications that the actual cobalt content of stainless steels be shown. The objective, of course, is the eventual elimination of all cobalt.

Pure materials are needed in electronic components to make the units more reliable in operation. In England, aluminum is being made to a purity of 0.001%. That degree of purity increased the shelf life of electronic capacitors by a factor of 10. In other European nations, aluminum is obtainable to a purity of 99.9999%. Pure metals for other electronic applications could guarantee more uniform performance of components.

Much must be learned about the effect of hydrogen on steel. It is well established that hydrogen has great effect upon the ductility of metals, particularly steels, and causes brittle failure. Why hydrogen causes this type of reaction is not known. Before much can be done to improve or to protect steels from hydrogen embrittlement, all aspects of the hydrogen problem must be studied. Then it might be possible to find means of removing hydrogen from steels or to offset its deleterious effects. It is hoped that some process to remove hydrogen from molten steel can be developed much like deoxidizers remove oxygen during melting.

Some researchers believe that the practical limits have been reached in the electrical conductivity of materials. Copper is now, and should continue to be the best practical conductor of electricity. However, basic research might reveal how conductivity can be increased in copper and in other metals.

There are probably many other subjects which could serve as the basis for fundamental research, but these are the ones that are most frequently mentioned. In the meantime, it might be possible to solve some of the immediate pressing problems by following the more practical paths of applied research.

The Immediate Problems

All of the fields of activity which were mentioned earlier as having many real and well defined needs are anxious to have immediately the improvements they cite. It is not likely that their highest hopes will be met soon, but in the meantime, any progress will be welcomed.

These are the general nature of some of the problems:

There is a need for better friction materials to be used as the brake linings for aircraft. With present aircraft landing speeds, the brake linings must dissipate 5,000,000 ft-lb of energy in less than 25 sec. In five years brake energies are expected to be about 25,000,000 ft-lb, and these must be dissipated in about 14 sec. The temperatures to be reached will be between 2000 and 3000 F. Two approaches are being considered. One involves the use of ceramic fibers to take the place of asbestos.

Needed. . . .

"A better understanding of helium and argon as to their differences in behavior when used as: (a) annealing atmospheres, (b) welding atmospheres."

At the same time, a more heat resistant organic bond will be necessary. Another plan considers the use of friction materials that use metal matrices. Some of the present metallic friction materials are being tried with modifications that replace all the metals that melt below 2000 F. With the higher temperature materials, it will be necessary to replace the present bronze matrix with molybdenum, titanium or some of the other high temperature metals.

One of the greatest immediate problems is finding new elements which will permit the making of alloys for difficult service conditions which will free us from our reliance on nickel, cobalt or molybdenum. There will probably always be some of these materials available, but they will have to be reserved only for the most stringent applications.

Rare earth metals are now being used to doctor the properties of many alloys. Before we can go much further with the use of rare earths it will be necessary to separate them and learn the properties of each of the elements in the combination so that we can know what the effect of each is on the various metals.

What seems to be a hopeless dream now, might possibly be a fact in the future. The tasks of a great many engineers would be made infinitely easier if we could develop a nonbrittle ceramic material. Some go so far as to ask for a ductile ceramic. Even a little progress towards reducing the brittleness of the ceramics both as solid pieces and as coatings would provide an answer for many of today's high temperature problems.

We must know more about steels and other metals in massive form. Most of the data now available is for materials up to 6-in. in size. Too, it is important that more reliable data be developed for cast materials. Many of the future uses of many of our important metals will be in cast shapes, so we must have realistic evaluations of their properties. It is felt, and probably with ample justification, that most of our castings are overdesigned. With better information on the strength properties of all casting alloys, it is reasonable to assume that important weight reductions could be made in many products without any change in materials. At the same time, we must learn more about the properties of cast materials under severe conditions over long periods of time.

Considerable cost savings could be achieved by developing methods of producing alloys directly from their ores, rather than going through a series of reducing and refining operations and then remelting to produce the exact metal mixture desired. Some of the recent steps toward continuous casting of metals for rolling will probably reduce costs somewhat, but more important cost savings might soon be necessary in order to offset some other costs which do not seem susceptible to reduction.

In the field of finishes and coatings, there are many uses awaiting self-healing coatings. The self-healing property would be valuable in many finishes and would solve many problems involving abrasion and other conditions which often cause the development of small surface openings in the coatings. Too, the cost of maintaining coatings is great, therefore, self-healing coatings would not only offer better protection but also reduce servicing costs.

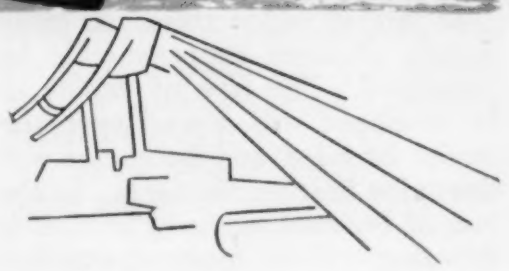
The Atomic Energy Commission needs many new materials and is presently investigating any material that seems to offer interesting possibilities. In addition to the absolutely pure materials previously mentioned, the AEC needs materials: (1) with low neutron absorption (such as zirconium); (2) with high neutron absorption; (3) with high reflectivity for neutrons and with low (or no) absorption.

These and many more problems will be discussed in the following sections of this report, both from the standpoint of the specific problems and of the various materials groups.

Materials with High Strength at High Temperatures

It is probable that the demand for materials that combine high strength with resistance to high temperatures is one of the most discussed problems of the day. It is likely that the problem will demand attention for some time to come with the continuing trend to higher temperatures in all types of equipment. The problems are as variable as the industry of this country is complex. The specific problems are different as they apply to different materials and different products.

For some materials and in some applications, high temperatures mean anywhere from 300 to 400 F all the way up to 3700 F. Time at tempera-



ture is an important factor. In some products, such as rockets, the time might be only a few seconds. On the other hand, the contemplated times might be 100,000 hr or more when the product involved is a steam turbine. In other words, times vary from an instant to more than 11 years. It is obvious that different materials will be required for most of these variations. It would not be good sense to use the most expensive materials where only short life is needed. On the other hand, it would probably be worth using the best attainable materials for equipment which might be required to operate for years and in which any repairs might be exceedingly costly. Too, the stresses might be relatively low on some of the materials at high temperatures, or they might be quite high, again depending upon the application.

The Problems

Part of the problem of selecting and applying high temperature materials is to find or develop procedures for testing the desirable properties at the temperatures involved. For example, the materials used to make strain gages are not suitable for making measurements at high temperatures. Some problems can be checked, however, such as erosion, corrosion and creep.

In aviation engines, particularly jets, engineering tricks and devices are being considered in the event the proper materials cannot be found. Cooling methods are being investigated to reduce the metal temperatures. One approach is to use hollow blades; other methods under consideration are transpiration (or evaporation) cooling or some other procedures. At present we do not know how far cooling can go without impairing efficiency below a practical value. The loss of heat means some loss of power, so a compromise will probably be necessary. The use of cooling might require the design of an entirely new engine at a cost of $15,000,000 to $45,000,000.

In aircraft alone there are many degrees of metal temperature to be considered. The type of engine to be developed will depend upon the service intended, and the engine will determine heat requirements. In the case of bombers, economy of fuel is important. Thus, many experts feel that the present engine materials are satisfactory. In fact, some engineers feel that the air inlet temperature is likely to be dropped about 100 F rather than increased.

In fighters, power and speed are most important. In turboprops, ultimate efficiency increases with higher temperatures. In straight jets it is also necessary that power—and temperatures—be increased. In turbine blades, 1500 F is often mentioned as the highest metal temperature, although there is some lack of agreement on this point. Others feel that the gas temperature will be about 1700 F and the metal temperature 1600 F. Still others predict 1800 F temperatures as being realistic.

The reasoning behind the 1600 F temperature estimate is that the maximum efficiency of a jet occurs when the speed of the ejected gas just equals the forward speed of the engine. At that point there is no thrust, but the faster the ejected gas the more inefficient the engine becomes and the greater is the fuel consumption; thus, a compromise is necessary. At the compromise point, the maximum metal temperature would be about 1600 F.

It is felt that even for blade temperatures up to 2000 F there are materials available. Up to 1600 F nickel and cobalt base alloys could be used. At higher temperatures, molybdenum or chromium could be used. The problem of coating molybdenum has not yet been solved, though, and chromium is too brittle. Cermets are not yet ready for use, according to many engineers, who claim that the cermets are satisfactory as far as heat resistance is concerned, but that they will not take the stresses. In addition, the cermets are difficult to fabricate and handle.

The thermal barrier involved in travelling at high speed causes many problems. Temperatures involved are not exceedingly high, but the combination of stresses, vibration and temperature create other problems. Here is how temperatures build up. At air speeds of 760 mph the rise in skin temperature of the plane is about 100 F; at double that speed, the temperature rises about 200 F; at 2280 mph, the rise is about 400 F.

Different but equally difficult materials problems must be met in other fields. For one chemical application, for instance, engineers are looking for a material that will withstand 100,000 psi pressure at 600 to 800 F and another which is capable of withstanding 500 psi at 2000 to 3000 F. Both materials would require a high degree of corrosion and oxidation resistance. These requirements exceed even the dreams of the AEC for many of its problems.

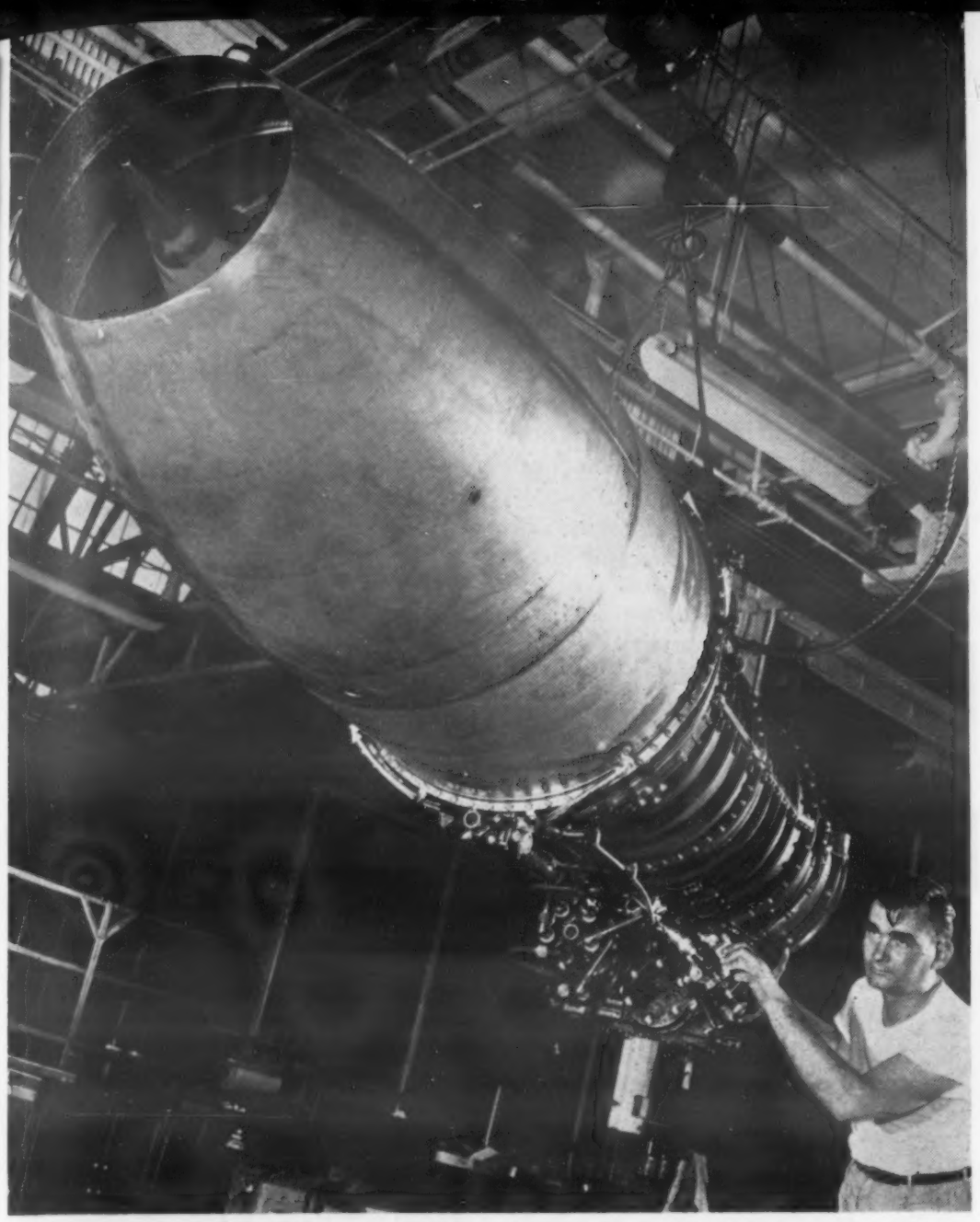
An increase in operating temperatures is also felt necessary in the turbines used for power generation. There are really two goals. Engineers are seeking to increase the inlet steam temperature to 1250 F in steam turbines. The top temperature steam turbines now in operation have an inlet temperature of 1050 F, and some units under construction will operate at 1100 F. The other desire is to increase to 1800 F the gas inlet temperatures in stationary gas turbines. The present top temperature is 1350 F. Unless new cooling methods are developed, the temperatures cited will also be the metal temperatures.

Materials are now available for the steam temperatures mentioned, but their properties are not as stable in large masses as they are in small parts. To some the 1800 F temperature materials for continuous operation in gas turbines is unrealistic, but that is the specified temperature. There are no materials for this application now, although some feel that titanium or molybdenum might be made to serve. Even though satisfactory materials are found or developed, there still remain the problems of joining and coating. Here again we must know about the long-time properties of materials, because they are expected to last a decade or longer.

In other applications involving high temperatures and high pressures, completely different requirements are listed. One application is carried on with pressures of from 800 to 2500 F and with temperatures of from 900 to 1100 F. Carbon steel,

Needed. . . .

"We are looking for a hard, durable machinable plastic to use for fabricating filling spouts. At present we use stainless steel, monel, or hard rubber, none of which are practical for use with all chemicals or liquid foods. . . . All the above materials mentioned come in contact with the liquids."



There is a constant demand for better and better heat resistant alloys for use in gas turbines.

3-in. thick, is now used for drums operating at 800 F; carbon-molybdenum steels, 18:8 stainless and some proprietary alloys are used for higher temperatures.

Now a material is needed for the next higher stage—to handle steam pressures above the critical pressure of 3200 psi. At this point steam and water have the same density and no BTUs are required to provide heat of vaporization. The result is greater economy of operation.

Here is how high temperatures affect the tensile properties of one important high temperature alloy:

At 1500 F the metal is designed to carry 23,000 psi (on 100-hr service basis)

At 1600 F allowable stresses would be 16,000 to 20,000 psi

At 1700 F allowable stress would be 10,000 psi

At 1800 F allowable stresses would be from 3500 to 6000 psi

Under those conditions, a part that is designed for 1500 F service would be underdesigned by a factor of four if sudden surges took the temperature up to 1800 F. Said another way, a 25,000-psi part at 1500 F will last 100 hr. The same part would only be good for 10 hr at 1600 F and only a few minutes at 1700 F.

What Materials?

Molybdenum is under serious consideration as a material for high temperature operation, although it is far from satisfactory now. At high temperatures, molybdenum is volatile and will boil away unless protected. Presently available ceramic coatings are not satisfactory as a protection for molybdenum. A slight pin hole in the coating will permit complete vaporization of the molybdenum and eventually leave only a ceramic shell.

As a solution to the molybdenum coating problem, nickel cladding is being tried. The results so far are promising. The nickel cladding is said to be self healing and thus capable of offering continuous protection. Others believe that a nickel-chromium alloy coating now being tried is the most satisfactory yet developed for molybdenum. It is probable that the eventual use of molybdenum will depend upon the development of alloys with nickel or some other element that is good for high temperatures. Forging alloys are available but greater ductility is necessary. Alloys have ductility about 100 times that of piece metal, but this must be improved by another 100 times.

Aluminum-titanium carbide metal powder products are being developed in England and are said to have promising high temperature properties.

Silicon-nitride is another material under consideration. The material is said to resist oxidation extremely well up to 2190 F and to show slight oxidation between 2190 and 2550 F. In addition to its high temperature properties, silicon-nitride is relatively inert to all organic acids and all concentrations and temperatures. No bonding agents are used in making the compound. Another possibility is molybdenum disilicide.

Chromium-base alloys containing 60 to 80% chromium show some possibilities for use up to 2000 F. The alloys have sufficient strength but have low ductility. They can be forged but not readily formed by other methods. Researchers are now seeking methods of providing better ductility.

In considering the cermets for high temperature applications, some weaknesses appear which prevent their adoption at this time. Many potential users have just about abandoned hopes of using cemented carbides to solve their temperature problems in jet engine applications. While they have the required strength they are too brittle. At room temperatures the impact strength of cermets is measured at about 1-in-lb. Metals are measured in ft-lb. The ductility is somewhat better at high temperatures but is not yet sufficiently high. Most engineers are adverse to using any materials that won't survive bouncing on the floor. Considerable damage could be caused by parts breaking loose inside the engines and striking the blades.

When the temperatures being considered are in the range of 900 to 1000 F, some of the low alloys seem to be better than stainless steels. The strength is good, but the surfaces must be coated for erosion and corrosion protection.

Other Needs

Some people do not seem to feel that we need new materials as much

as we do a classified list of materials that can be used under various conditions at temperatures ranging from 800 on up through 2100 F. One request for such information came from a manufacturer who must select materials for combustion chambers and burner parts which normally operate at from 1400 to 1800 F.

Materials are needed to withstand the erosive effects of high temperature gases. In rockets the gas temperature often reaches 3700 F. Some of the materials only require their strength for a relatively short time, but they must be dependable for that period. The materials for high temperature should be readily castable or machinable and capable of being cemented to metal surfaces. Graphite meets some of the requirements but not for sufficiently long times.

In this portion of the discussion of new demands in engineering materials, our attention has been devoted largely to the constructional materials which might be used. There are many other problems which also arise, such as lubricants, bearing materials, gasketing materials and joining materials which can also survive under the temperatures under discussion. Most of the specific problems in these types of materials will be considered separately in appropriate sections of this report.

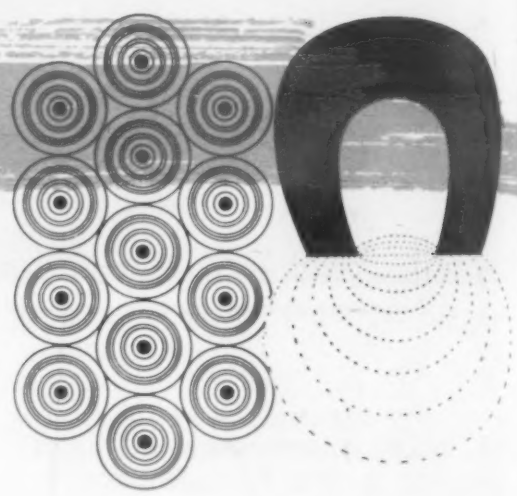
New Demands

Lead to

New Directions

In Engineering Materials

Materials with Better Electrical Properties



Today, so many types of equipment are controlled by electronics and electricity that the failure in the materials used for any of these applications might have serious and costly results. In addition, there are great demands for reductions in sizes of electrical components. To make units smaller and lighter requires better current carrying materials, better insulating materials, and better lubricating and bearing materials. In addition, better magnetic properties are needed in both hard and soft materials and higher purity in materials used for all kinds of electrical and electronic applications.

During the past few months we have heard a great deal about germanium and its use in transistors. At the same time, considerable work has been done in the development of magnetic amplifiers and dielectric amplifiers. Although used for somewhat different applications, all of these devices are being devoleped for the similar purpose of providing more uniform and dependable service in many units which now rely entirely upon electronic tubes. Military radar and the so-called "electronic brains" are applications in which transistors and amplifiers will be used soon to overcome the problems of tube failure. Some hearing aids are using transistors to permit important size reductions not only in the electrical circuit of the devices, but because they require less power in the batteries. Right now there is quite a controversy raging over the reliability of transistors in hearing aid use.

It is generally assumed that methods will be developed to reduce the number and size of electronic tubes in many applications. It is far from certain what materials will be used to achieve this end. Germanium was the first to attract attention for transistor applications, but its high cost led immediately to a search for other materials which might serve. The next step was the use of high purity silicon for the same purposes. Silicon is almost as expensive, but possibly more readily available. Now we have an entirely new material which seems to excel in the properties needed for transistor service.

Recently an aluminum-antimony alloy was developed which has the same metallic structure as germanium and the same electrical properties as silicon. There is a good possibility that this material will take over the applications already assigned to silicon, particularly for high temperature applications where the new material has superior properties.

In electronic tube applications there is a strong need for pure, nonporous metals such as steel, cupronickel, telnic and phosnic. The pure materials are wanted particularly for microwave tubes. At present, most of these materials are porous and it is necessary to resort to laminating or orientation of stock to prevent leaks in the vacuum walls of electron tubes.

Purity is required in all electrical materials to make them more reliable in service and to improve their properties. An example that is cited is the case of high purity aluminum which has been developed in England. There, aluminum is available that is pure to 0.001 parts. That improvement in purity has resulted in an increase in shelf life of capacitors by a factor of ten.

As was mentioned in an earlier section of this report, there is a great need for greater electrical conductivity in the common current carrying materials. We appear to have reached the maximum in conductivity in copper and other metals used as

conductors. Materials with increased current carrying capacity would be extremely helpful in achieving the smaller sizes which appear to be so urgent in electrical components.

As in all other fields of activity, there appears to be a mild revolution in the materials used for electrical applications. One example is in the use of magnesium to replace zinc in dry-cell batteries. The result has been lighter weight, greater watt-hour capacity, and about twice the active life. Other battery combinations are also being made and tested.

Magnetic Materials

Research has been somewhat slow in developing information about soft magnetic materials. It is important that we know more about the fundamental properties of these materials before we can achieve two major aims, which are (1) higher saturation to permit smaller sizes, and (2) the development of two usable magnetic directions rather than one.

Some progress has been made in achieving these properties, but the most satisfactory answers do not yet seem to have been found. Higher saturation is possible with the use of cobalt, but this is expensive when added to the ordinary silicon steels. Two magnetic directions have been achieved in some aluminum steels, but at the present time it appears more important to develop the same properties in the silicon steels which have been so important in the development of smaller and more efficient electrical transformers. Here is a place where basic research might show why two directions can be achieved in one alloy and not in the others. The knowledge might permit adaptations of silicon steels to give similar properties.

Improvement is expected in all types of magnetic materials when more is learned about basic metal structures. Among the improvements expected are materials with lower magnetic losses and materials which can handle larger fields.

Because of the continuing scarcities of alloying elements, such as cobalt and nickel, it is important that we develop permanent magnet materials that have properties similar to the Alnicos, but do not use the scarce alloys. One substitute material is a ceramic type made of barium and iron oxide which can be used in place of Alnico V, although its properties are somewhat inferior. Manganese-bismuth alloys also show promise, and one of these compounds has an energy product equal to Alnico V.

Other specific developments which are needed in magnetic materials are:

New materials to serve as substitutes for critical alloys, such as 37% cobalt steels.

A soft magnetic material with a squarer hysterisis loop than present materials.

A magnetic material whose core losses increase at a greater rate with frequency increases. And,

A magnetic material which can produce the same flux density as Alnico V, but which has only half the volume and half the weight.

Insulating Materials

Probably the most important single need in the electrical field as far as the range of applications is concerned is for better insulating materials. Superior insulating materials are needed for capacitors, for ordinary electric motors, and for equipment to be operated at extremely high and extremely low temperatures. Materials involved are synthetic micas, enamels, plastics and synthetic rubbers, as well as silicones and impregnated paper. Better insulating properties are needed to save space and weight. Thinner sections of insulation are needed for given voltages. One of the major problems is the increasing usage of equipment at high temperatures.

Among the dream-type requests for insulating materials are these: "We would like a 5-mil sheet of insulating paper so good that one thickness could be used with the knowledge that no conducting impurities or thin spots would allow conductance or breakdown. Even the use of two thin sheets would be a step forward." Another engineer wants some material with "as good a power factor as mica, but giving smaller capacitors for the same rating to meet the needs of the miniaturization program."

Needed. . . .

"A material having the properties of metals but at the same time being a dielectric."

Needed. . . .

"We have a requirement for a suitable plastic material for our tractor radiator grille. This should have similar characteristics to form sheet metal. The design is louvered with the open spaces backed up with a screen mesh to prevent foreign materials, such as chaff and bugs, from entering the radiator."

Sheet mica is now being made by pressing and sintering flakes of two different compositions without a binder. The flakes are held together by natural cohesive forces. The material replaces natural mica in vacuum tube spacers, and at elevated temperatures is superior in insulating properties and outgassing characteristics.

Another synthetic mica is a fluorine-mica composition that is made by hot pressing. The material is soft and machinable like talc. The synthetic compares with fused silica and steatite in electrical insulating properties and can be used at higher temperatures than glass-bonded mica.

Another important development in mica-type insulations is a material known as mica-mat. The material is made from scrap mica which is processed into flexible form by a process related to paper making. The basic material is then frequently given a surface treatment with a resin or silicone material. Mica-mat is said to be as good as the best flake mica and can be made from domestic mica as well as scrap. Because mica-mat is uniform in thickness it can be used in thinner sections for any given jobs than can most similar materials. It is also flexible and workable. At present the material is relatively high in cost, but extensive application is anticipated when and if costs can be brought down.

There are numerous requests for machinable insulating materials that will withstand temperatures of 300 F or higher continuously and have lower water absorption rates than currently used materials. To be most helpful, the materials would be available in sheet or tube form. For the intended applications, glass fiber reinforced materials are not suitable.

Some of the plastics and other synthetic materials come close to

Needed. . . .

"Alloys, 1000 F series and 2000 F series, for long term high temperature, high loading conditions. Desire light weight, good corrosion resistance, ease of machining, low temperature coefficient, etc., for valves, pipes, fittings, for heat and vent systems in aircraft, industrial control, and similar applications."

meeting many of the present insulation requirements, but all seem to fail in one or more important characteristics for their intended uses. The silicones are good for about 480 F, but some materials are needed for temperatures higher than that. Two of the fluorocarbon plastics are used extensively because of their electrical properties. One of the more prominent has excellent electrical properties and the other has outstanding mechanical properties. What is needed is one material which combines the outstanding properties of both.

Here are some of the current insulating materials problems:

Of course, one of the most common is a material capable of resisting the hot spots which develop in electrical equipment. Resins are needed also to resist high temperatures for long periods of time.

For use in the range of 350 to 400 F, there is a need for a good wire enamel and a superior varnish that is solvent resistant. Also, potting resins are needed for the same temperature range.

There is a need for a low cost plastics insulating material available in sheet form that has strength comparable to that of nylon.

Another request is for an insulating material other than mica or ceramics that is suitable for temperatures up to 800 or 900 F.

Some specific problems could be solved with an insulated wire less than 0.0008 in. in dia with a mass less than that of aluminum.

Apparently developments in England have made possible better capacitors than we are yet capable of producing. Users report that the metallized paper capacitors in that country are superior to ours.

In this country capacitors made of alternate layers of enamel and silver are being introduced in order to circumvent the use of mica. Others are being made of glass fibers and aluminum, with the entire unit covered with glass. Both of these developments will make possible size reductions.

Other Electrical Materials

Printed circuits which have been gaining in importance since late in the last war will be relied upon to reduce the weight and space requirements of electrical and electronic devices. To take proper advantage of the possibilities of printed circuits, we need better adhesives, insulating coatings and conductive inks. Improvement is necessary to permit better printed circuit operation. The difference in the coefficient of expansion of the resin, the adhesives and the metal foil is a big problem.

In miniaturization, one of the big obstacles is the lack of heat resistance in organic insulating materials. The smaller the parts, the greater is the difficulty in dissipating heat.

Many casting and potting compounds are needed for electronic equipment. For one application, these are the specifications for casting resins:

(1) They must have low viscosity for complete impregnation at reasonably low temperatures. (2) The resins should set with a minimum of shrinkage or expansion. (3) They should have good dielectric properties. (4) An ability to withstand repeated cycling from 400 F to —65F is necessary without fissures or loss of adhesion to embedded materials. (5) They should not corrode embedded materials. (6) They should gel and cure quickly and should resist flow or distortion at operating temperatures.

One potential user is seeking a contact material with an electrical conductivity rating of 85%. This material would be equal in conductivity to the 85 silver, 15% nickel alloy, but would be harder, contain no nickel, be non-magnetic. The material should also be capable of withstanding thermal and mechanical shock. Furthermore, it should be readily available, inexpensive and easily brazed to copper. Another contact material need is for an alloy that will stand up well under both arcing and mechanical wear.

For use in electrical equipment there is an apparent need for a better and less expensive current carrying spring material to take the place of beryllium-copper, which is becoming scarcer and more expensive. This need might be filled with a new alloy recently announced by Battelle Memorial Institute. The alloy, a copper-nickel-silicon-aluminum composition, is intended to replace beryllium-copper where maximum strength levels of that alloy are not needed. The new alloy has yield strength levels of the order of 120,000 psi, better proportional limits at this level than beryllium-copper, and a conductivity 11% that of copper. The new alloy can be formed before age hardening, and in the worked and aged condition, has better overall properties than beryllium-copper under the same conditions.

Much progress can still be made in proper design and selection of materials, parts and forms to reduce scrap and improve performance.

New Demands
Lead to
New Directions
In Engineering Materials

Materials for Corrosion Resistance

Many of the corrosion problems which face us today are directly related to the use of higher temperatures and pressures in transportation and chemical processing equipment. In those applications, corrosion results from the reduced resistance of the materials to withstand the attacks of oxygen. There are many other types of corrosion which are equally troublesome, however, and lack of materials to meet conditions now with us, or anticipated, are the objects of countless searches.

While the conditions which must be survived by materials are getting more severe, we will probably have to learn to do without some of the present alloys which are most satisfactory for corrosion resistance. The reason is, of course, the present and anticipated shortage of nickel and cobalt. Therefore, the engineers of the country are being forced to seek replacements for stainless steels and other high nickel alloys.

Replace Stainless Steels

Shifting from the 18:8 stainless steels to save nickel will probably result in (1) steels having a ferritic structure; (2) steels having a duplex (ferritic and austenitic) structure; and (3) steels using austenite formers other than nickel. At present, manganese is the most likely substitute material for the latter condition. The low carbon, high chromium steels are a start in developing a duplex structure material to replace 18:8. Developers of the low carbon, high chromium steels are still testing their new alloys. One of the alloys contains 21% chromium and less than 6% total of nickel, molybdenum, copper and manganese.

One of the problems in replacing stainless steels is not only to find materials that have comparable corrosion resistance, but also to find materials which have satisfactory fabricating or processing characteristics.

Where stainless steels are not satisfactory, as for example against pitting corrosion, or where high alloys (such as Hastelloys) have been used, attempts are being made to use alloy materials containing higher percentages of iron in order to lower materials costs. One example is a new nickel-chromium-molybdenum-iron alloy containing about 18% iron.

One of the greatest needs is to find a material to replace stainless in making corrosion resistant mechanical parts. Fairly high properties would be required so that no plating would be needed. It is possible that a nitriding type of steel will be developed which will have good corrosion resistance and which will not distort in heat treatment.

Some, concerned with the problem of corrosion, are going in the other direction and are planning to use alloys that are higher in alloy content and more expensive as replacements for stainless steels. When all cost factors are considered, such steps might be more economical in the long run. Coating of lower alloys, for example, is expensive.

Ultimately, it is probable that titanium and zirconium will find considerable use in corrosion resistant applications. These materials can handle boiling concentrated nitric acid and many other highly corrosive chemicals. Their high original cost could be offset by the long life which could be gained for equipment made of these materials.

There is a need for a good corrosion resistant material to be used in all types of parts such as gears and bearings which cannot be plated because wear involved would quickly wear out most plating materials.

An increasingly perplexing corrosion problem is contact corrosion such as that which develops under gaskets and other sealed areas. Some look to the use of thin sheets of titanium or some of the higher alloys to be used in such places to protect the base metals.

Coating Cast Iron

On interesting problem is to find an economical process for coating gray iron and malleable iron used in valve bodies to protect them against fresh water corrosion. Vitreous enamels have not worked well in this application, due to the cost of application and the difficulty in machining after enameling. Too, hot dip galvanizing has not proved highly satisfactory for much the same reasons. A possibility would appear to be a plastic coating which will adhere to the iron surfaces and be impermeable to water when constantly submerged. Perhaps one of the new ceramic coating processes will find use here.

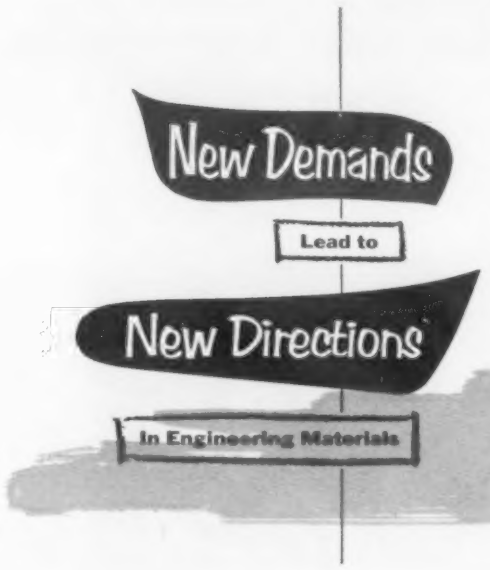
There also appears to be a need for a highly corrosion resistant spring material which is low in cost. Plating tends to create hydrogen embrittlement and, therefore, cannot be used. In addition, the material should have a yield point higher than the present spring material and have a lower creep rate at the boiling point of water.

Many plastics materials do have the necessary corrosion resistance to handle many applications, but they are lacking in other properties. The same is true of natural and synthetic rubbers. However, there are some demands which probably can only be met by nonmetallic materials.

One such material sought is an elastomer that is resistant to high temperature fuels at temperatures of from 300 to 400 F and which will also have flexibility at —65 F. It should also resist high temperature acids such as fuming nitrics and be compatible with 90% hydrogen peroxide.

Another nonmetallic material sought is a synthetic material which has the strength and resilience of synthetic rubbers such as neoprene and Buna-N and still has a high resistance to the deteriorating effects of solvents, such as acetone, methyl ethyl ketone and lacquer thinners.

Other specific problems dealing with the handling of corrosive materials are discussed in the section dealing with finishes and coatings, which appears later in this report.



Materials with Other Special Properties

We have already discussed the need for material having better high temperature properties, electrical properties and corrosion resistance, but there are other special properties that are needed. In many types of products a special combination of properties is often desired. Many of the properties indicated are present in available materials, but these materials might be too costly, too hard to work, or too scarce. In other cases, it would be helpful if superior properties could be found in inexpensive materials or if what now seems to be impossible combinations of properties were to be attainable in any materials.

Lubrication and Bearing Properties

Despite the hundreds, or perhaps thousands, of lubricating materials, there is still an insistent demand for better lubricants to meet the conditions imposed by the service requirements of the new and reengineered devices coming into being. Likewise, the need for better bearing materials continues.

Among the reasons why engineers seek better lubricants and bearing materials, these seem to be the most important:

Rotating equipment is being designed for operation at higher speeds.

Many types of equipment are built to operate for many years without any servicing.

Top and bottom temperature limits are being extended in components for all types of end service use.

Some motors are designed for service at both extremely high and extremely low temperatures, with the transition from one to the other often being completed in a matter of seconds.

Many kinds of electrical equipment are being made to conform to the trends towards greatly reduced size. With the size reduction comes an increase in operating temperature and, therefore, a problem in lubrication. Heat cannot be dissipated so readily by small components.

Needed. . . .

"For automatic valve applications in compressors we are looking for a material that is very light, strong, and has a high resistance to abrasion."

Lubrication and Bearing

Sealing and Gasketing

Thermal Insulation

Low Temperature

Abrasion Resistance

None of these objectives could be reached without adequate lubricants or bearings. Although there are many specific properties desired in both classes of materials, these requirements cover the majority of cases. (1) lubricants and bearings for high temperatures; (2) for extremely low temperatures; and (3) materials capable of operating under both extremes of temperature.

Lubricants

Here are some of the specific requirements which have been established for lubricants:

One potential user of the desired material wants a lubricant with constant viscosity and low shear charac-

teristics over a temperature range of from —65 F up to 160 F. The lower limit cited is about the lowest desired, but others would like the upper temperature limit to be somewhere in the neighborhood of 400 F.

For equipment to be used in aircraft, the requirements vary somewhat. For example, these are the specifications established by one group: "A grease for small ball bearings that will have satisfactory low viscosity at —67 F to permit quick acceleration of low torque motors and to permit 1000-hr operation at a bearing temperature of 410 F".

In refrigeration and air conditioning equipment these are the problems which make better lubricants imperative: Machinery for this service is being made to operate at increasingly lower temperatures and at higher compressor heat temperatures both for Freon and ammonia types of refrigerants. The answer might lie in mineral oils or synthetic oils.

A possible lubricant for hydraulic equipment is one that would meet several difficult requirements. Here is what is asked for: A lubricant with long life to seal leather Vee rings in contact with bronze shaft sleeves revolving at 3500 rpm. The lubricant should provide extremely thin film protection and resist the leakage of cold water under 50- to 100-lb pressure. In addition, it should not show any tendency to be soluble in or to emulsify with the water and should show minimum tendency to creep. The ultimate lubricant should be either a fluid or an oil type, or an extremely soft grease.

In electrical switches there is a need for a lubricant to be used on contacts which will not only lubricate, but which will also remove oxides, prevent corrosion and reduce arcing. For instruments, a nongumming lubricant is a must.

Other greases are sought for ball bearing use which must stand up under temperatures of over 347 F and also withstand severe vibration without breaking down.

In lubrication, the trend is towards the costlier synthetic materials. At present, the lithium-base lubricants appear to be the best, although those with a silica base show considerable promise.

Bearing Materials

Some of the requirements for bearing materials seem rather difficult to attain, but the insistent demand might bring into being materials whose properties approach the ideal. Among the objectives sought today are these:

Better underwater bearing materials.

A good bearing material with increased fatigue strength, resistance to corrosion and reasonable imbedability, but less expensive than the silver alloy bearings now in wide use.

For Diesel engines there is a need for better aluminum bearing materials that can withstand higher temperatures and be more tolerant of dirt than are the present aluminum bearing materials.

For bearing applications there is a need for a material which can withstand high temperatures. The material should combine good corrosion resistance and the ability to function at temperatures that do not now permit the use of normal lubricants. High-speed steels, high cobalt alloys, tungsten carbide and ceramics have been used, but none meet all the requirements including high temperature properties, nongalling properties and sufficient machinability to keep fabricating costs down to a reasonably low level.

Needed. . . .

"A low carbon steel sheet material which can be readily formed by the same methods as SAE-1010 but is rust resistant. This would be useful for office equipment and many other applications if the price were low enough."

Sealing and Gasketing

Some of the same problems which have resulted in a search for better lubricating materials can also be applied to those materials which are used for making gaskets, packing rings and sealants of several types. The miniaturization of electrical equipment and the desire to make it service-free for long periods of time demands better sealing materials. Higher pressures and temperatures impose new problems on gasketing materials. In addition, the materials used for gaskets are now being required to handle many corrosive materials. When several of these requirements are to be met in the same application, the problem of finding an adequate material becomes quite complicated.

Gasketing Materials

Following are some of the properties now sought for gaskets and seats for valves.

One potential user wants a gasketing material that will hold Freon gas and resist high bolting stress without flowing and still be soft enough to make a tightly sealed joint using ordinary machined surfaces.

Another would like a material for packing and sealing washers that is inert to all chemicals. Some of the new plastics materials meet the latter requirement, but they are too hard in their present formulations. The ultimate material must be flexible, resilient, as well as have the indicated chemical resisting properties.

Better valve design awaits a plastic seal material that is truly elastic or a seal material that has less cold flow than presently available materials for the temperature range of —65 to 160 F. Others are interested in a gasket material for approximately the same temperature range, but want the material to be capable of effecting a good seal on rough surfaces.

Needed. . . .

"As manufacturers of gas and electric domestic water heaters, we are looking for a material that can be used to either make a water heater tank or be used as a lining in a steel tank. We are looking for a material that can be used economically at pressures up to 300 psi and temperatures up to 180 F. The material should be highly resistant to corrosion under extreme water conditions, especially water that has a high chloride content."

For other anticipated uses, the top temperature limit climbs up to 1000 F; and for still others, the material must be good between 1000 and 2000 F, and at the same time withstand high pressures. Some applications need these properties in addition to the more frequent requirement that the materials withstand corrosive media.

On some types of electric and electronic equipment, efforts are being made to eliminate the use of gaskets. Such a step depends upon better glass-to-metal seals, glass-to-ceramic seals and effective seals between other dissimilar materials.

Sealing Materials

Although hermetic seals for many types of equipment are quite satisfactory for present-day service, increasingly tough service conditions make imperative further improvement in the sealing agents.

One request is for a bonding and sealing agent that has high dielectric strength and that is capable of withstanding moderately high temperatures. The material is needed to form a hermetic seal on relays and switches and replace the glass seals now used.

It is hoped that some better casting resins will be developed for electronic applications. Among the properties and requirements are: Low viscosity for complete impregnation at a reasonable low temperature; minimum shrinkage or expansion on setting; good dielectric properties; and, the ability to withstand repeated cycling from 392 F to —67 F without fissures or loss of adhesion to embedded materials. In addition, the resin must not corrode the embedded parts, should jell and cure quickly, and resist flow at the operating temperatures.

A sealant of a different type is another desired material. In this case it is expected that a wax might provide the answer. The material should be capable of spray-sealing for use on water-impervious packages. The material should also be nonbrittle at 50 F and be subjected to continuous 250 F heat without deterioration.

Other Needs

Low Temperatures

There is apparently a need for better materials to serve under extremely low temperatures, although at this time the qualities that will be needed have not been defined with any great degree of accuracy. Most of the current low temperature problems can be met with austenitic stainless steels, certain bronzes and 3½% nickel steels. However, these materials cost too much for many large scale applications and contain elements that are scarce and of strategic importance. So the first problem is to develop materials with properties similar to those of the properties listed but which do not have the same elements in them.

High-speed aircraft require materials with unusual combinations of properties, such as high and low temperature strength, corrosion resistance and resistance to erosive effects of rain.

Needed. . . .

"We are very much interested in locating a material which we are sure does not yet exist; namely, a light weight insulating board of good insulating properties, which will not transmit moisture and which can withstand reasonably heavy impacts without puncturing."

In the future materials will be needed for some chemical processing jobs where the temperatures will go from —50 to —240 F. Among the problems present is the need for gasketing materials that will remain flexible at low temperatures. Some silicones are now available that meet this requirement, but they are extremely expensive.

Rain Erosion

Materials are needed to withstand the erosive effect of rain against high-speed aircraft. Either a solid material or a coating would be acceptable. Glass-reinforced plastics erode rapidly at 400 mph and up when used for wing leading edges, radomes and in similar applications. Even metals erode at high-speed levels. Elastomeric type materials seem to offer the most promise. At present, an air drying special neoprene is most satisfactory. That material, used as a 10 mil coating, withstands rain erosion for about 2 hr at 500 mph

and is now being tested at speeds up to 1000 mph. Any coating developed should be usable in thicknesses not exceeding 10 mil and must be air-drying to permit field application.

Thermal Insulation

Better heat insulating materials are needed. For one, there is a demand for an insulating material to be used in refrigerator boxes that will provide the same insulation as present materials, but will only require 1/3 to 1/2 the space.

Insulating materials for both high and low temperatures are needed They should be moisture proof, capable of use over a long temperature range, be of low weight and volume, be inexpensive and be castable. The foamable plastics seem to meet most of these requirements, but those available now are too expensive.

Other Unusual Properties

For applications involving long time high loading conditions at temperatures of from 1000 to 2000 F there is desired a material that is light in weight, has good corrosion resistance, has a low temperature coefficient, and is easy to machine. Such a material would find use for valves, pipes and fittings for heating and ventilating systems in aircraft and industrial control systems.

There is a continuing need for material of which to make molds for the casting of copper and copper alloys. Among the uses are continuous casting of copper and the die casting of brass.

Honeycomb structures appear to have many possibilities in industry. They can assist in reducing heat transfer. Aluminum with organic adhesives have only limited possibilities so we are looking towards stainless steel honeycombs made by brazing. Titanium honeycombs would also be valuable if simple and reliable brazing techniques are developed.

There is a desire for casting alloys which have greater strengths than those now available and which have higher current carrying abilities.

A good spring material is needed for extremely high temperature applications.

Noncorrosive, slow work hardening alloys which can be readily upset are being sought. Some of the present alloys which are satisfactory require nickel. Nonferrous alloys now available are too weak for the intended uses.

A variety of materials is sought which can stand up in water at 400 to 700 F and steam at higher temperatures without excessive corrosion. Some of the problems encountered are akin to those present in steam turbine operation.

Temperature stable materials are wanted. That is, materials with a low thermal expansion coefficient of a negative coefficient.

One user asks for a metal which can be hardened economically to give extreme abrasion resistance such as is needed in pumps which are designed to handle abrasive fluids.

One of the most unusual requests is for a metal with dielectric properties.

Tungsten carbide is now used to make gyro anvils, but another material is wanted. The material would have a yield strength of over 300,000 psi and a low modulus of elasticity. In addition, it would be sufficiently ductile so as to stand up under impact, have a low coefficient of friction, and be either castable or machinable at reasonable cost.

Another request is for a metal with the same mechanical properties as steel but having the light weight and the corrosion resistance of aluminum. Apparently titanium will not serve.

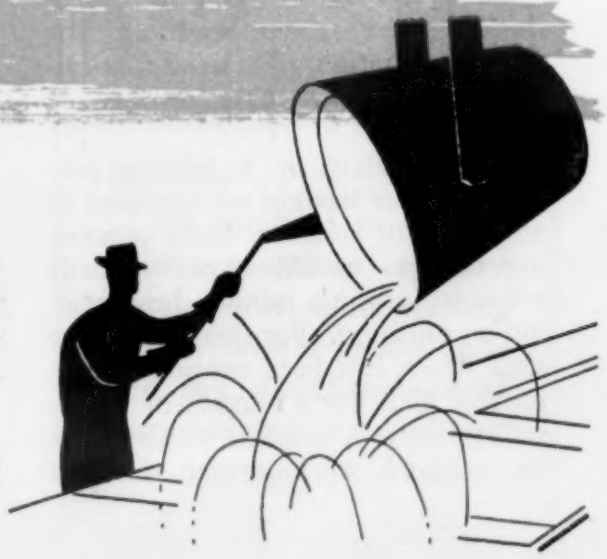
For use as the active element in thermal controls and indicators there is a need for a material that will withstand high temperatures, have a high coefficient of expansion, and be capable of being stabilized to eliminate creep.

In the field of liquids there is a request for a material that has exceptionally high thermal expansion for use in thermometric and thermostatic devices.

Irons and Steels

Despite all of the new materials which have come along during the last decade, there is still more iron and steel being used than ever before. With all of the increase in steel mill capacity, there is still insufficient steel for certain applications. In the immediate future, steel is expected to be used more extensively than ever before in airplane construction. Aircraft will rely upon steels especially where the combination of high strength and high temperature is a requisite.

At various times, aluminum, magnesium and plastics have threatened



the future of steel. Now, titanium and the newer reinforced plastics again offer a threat. However, steel still retains the very considerable advantages of low cost and superior strength.

Two trends are strongly evident now in connection with the use of steels. First, there is a decided movement away from the highly alloyed steels for many uses. High relative cost and the shortages of necessary alloying elements have speeded this trend. Second, almost unheard of strength levels are being sought in steels. Some future developments are based upon the use of steels having tensile strengths in the neighborhood of 300,000 psi. The desired strengths are attainable, but these, combined with the other necessary properties such as low notch sensitivity and high impact strength, will be harder to obtain.

The most generally heard plans concerning the future use of steels discuss the adoption of low alloy steels. The term is somewhat confusing because several different steels are being covered by the same term. Some people are referring to the class of steels known generally as high strength, low alloy steels; others are including the carbon steels, and still others mean steels of lower alloy content than those now used to achieve desired strengths. Actually, there are important plans for all of these groups. Already there is a greater dependence on heat treating rather than alloying elements to achieve high strength levels.

Stainless steels which have good high temperature properties are being replaced by other steels of considerably lower alloy content with good results. In fact, some users who have made such changes report even better results. Strangely enough, the replacement of stainless with a less highly alloyed steel does not always result in reduced costs. In many cases the carbon steels must be coated with some protective material to enable them to stand high temperatures. The coating operation, plus some fabricating complications, have resulted in higher costs.

Unfortunately, it is seldom possible to make straight substitutions of one steel for another. Some processing changes usually must be made either in forming, joining, heat treating or finishing. For this reason one steel which had been considered reasonably good for a number of different service requirements usually must be replaced with several different steels, each being chosen for its own best properties in relationship to the application.

Needed. . . .

"We manufacture booms for truck cranes and also make derricks, cargo booms, etc. In almost all cases structural steel is used. The ideal would be to use a metal with the same physical characteristics as steel but with the light weight and corrosion resistant properties of aluminum."

There are many things which must yet be known about even the ordinary steels. The "why's" of impact resistance, notch sensitivity and fatigue are still mysteries. Until more is known about why these properties exist, it will probably be necessary to continue to overdesign steel parts.

Overdesign is also made necessary by the lack of uniformity in steels from lot to lot and even in the same piece. Test specimens taken from one area will often show entirely different properties than another taken from the same bar. No one knows why this is true, but there is considerable agreement that the situation does exist. Steel is not the only material in which this difficulty is found, but because its tonnage is so great, the problem is greater with steels.

There is a growing trend in steels to specify them according to desired properties, rather than to a specific chemistry. The so-called H-steels which are slow to be accepted are a part of this trend. The changing situation in alloying elements has had much to do with forcing a break with tradition. Certain steels might not be available, but if only a certain property is desired, there are probably several other steels which could perform satisfactorily. If the choice of chemistry were left to the steel producers, most demands could be met.

High Strength Steels

In the aircraft industry there are great hopes for the high strength steels. Steels having tensile strengths in the range from 180,000 to 300,000 psi are probably going to be used for a great many aircraft parts. Larger and more powerful engines require mounts and supports that can withstand terrific stresses. Heavier aircraft will require superior strengths in many parts such as landing gear. In the latter case some engineers are considering the use of thinner sections of high strength steel in landing gear. They are talking about steels in the 240,000 to 280,000 psi tensile strength range. At these strengths toughness decreases, so tests are being conducted to determine whether the drop in toughness will be detrimental.

Both 4330 and 4340 steels are being investigated. It has been found that a lower carbon limit helps to minimize the falling off in toughness. An example cited is the use of 4330 rather than 4340. The lower carbon steel is quenched in oil rather than water and then tempered at temperatures in the 300 to 450 F. range, rather than at 600 to 800 F. Added toughness is also expected through the addition of rare earths. Transverse strength will also be increased through rare earth additions.

Needed. . . .

"The microwave tube industry would be aided greatly if pure, reliable, nonporous metals were available, i.e., steel, cupro-nickel, telnic, phosnic. As presently supplied by most vendors, these metals are porous, and one must resort to laminating or orientation of the stock when manufacturing parts in order to assure that leaks will not be present in the metallic vacuum walls of the finished electron tube. Occasionally, even lots of so-called "electronic grade" nickel are porous."

Notch sensitivity in the high strength steels is the chief factor holding back its wholesale adoption. Applied research directed at this problem should result in a satisfactory solution before long.

Reports are that many steel consumers like the boron steels, but that the steel producers are not too anxious to handle them. Thus, the boron treated steels have not been pushed as strongly as they probably will be. The boron steels can be made even better by the addition of Misch metal, and investigation into its use is continuing. By adding 3 to 5 lb of Misch metal per tool of steel, interesting results can be obtained. The impact strength of 8640 steel is about 30 ft-lb, but by adding Misch metal, impact strength has been raised to 40 to 50 ft-lb. Researchers say that Misch metal serves to promote the formation of globules of slag rather than stringers.

The widened use of the high strength steels will also depend upon finding suitable coating materials and satisfactory fabricating processes, particularly for welding. Problems of this nature are involved down to the 180,000 psi strength level, if not lower.

In using high strength steels in thinner sections than have been used up until now, there is some concern over the rigidity of sheet bar or plate. Since modulus of elasticity remains appreciably the same regardless of strength, there are practical limits of thinness of section that can be used in many applications, particularly where transverse loading is involved.

Some investigators of the ultra-high strength steels report what they term static-brittleness. They say parts might fail under purely static tensile stresses because of the gradual transformation of retained austenite. The materials withstand dynamic loading without difficulty. Surface treatment of the high strength steels by cadmium plating is not proving too satisfactory because of the constant possibility of hydrogen embrittlement.

Needed. . . .

"Noncorrosive spring materials which have higher yield points than present materials and which have lower creep rates when used at temperatures above 100 C are very greatly needed."

Needed. . . .

"Electrical insulation: Many problems would be simplified if there were electrical insulating materials, other than mica or ceramics, suitable for use at temperatures up to 800 or 900 F."

Stainless Steels

Many of the changes in the use of steel are of direct concern to the producers and users of the stainless steels. In many instances, the shift away from stainless is due less to any dissatisfaction with the steel than to the urgent necessity of finding steels with lower alloy contents. The biggest concern is, of course, nickel.

Renewed research on a long abandoned series of steels has resulted in some new steels which can replace the chromium-nickel stainless steels for many applications in which heat is not a factor. There are several different approaches, but the use of manganese to replace nickel seems to be the most satisfactory answer. One of the chromium-manganese steels which is being considered as a replacement for Type 302 stainless contains 10 to 13 chromium, 15 to 16 manganese, 2 copper, 0.50 to 0.1 carbon, and 0.3 to 1.0% silicon. There is a great similarity of properties in the two steels.

It is too soon to tell exactly where the new steels will fit. They have been developed so recently that comprehensive tests have not yet been completed. Several companies are experimenting with steels of the manganese-chromium type, so adequate performance data should soon be forthcoming.

Apparently some users of stainless steels which must be welded are coming to favor the extra low carbon stainless over the columbium stabilized Type 347. The latter steel is often specified where Type 304 with extra low carbon would be better. One example of the advantages of using Type 304 is in the manufacture of petroleum cracking units which operate in the 1250 F-range. There are no aqueous vapors present, so Type 304 works satisfactorily, while Type 347 has a tendency to develop hairline cracks over long periods of time.

Due to a lack of certainty as to whether new sources of nickel will be discovered and developed in time to meet the constantly increasing demands for steels having many of the properties of stainless steels, it is probable that several new types of steels will be developed. The following types are anticipated: (1) steels of the ferritic type; (2) steels having a mixed or duplex structure (ferritic and austenitic); and (3) steels using austenite formers other than nickel, such as manganese and nitrogen.

One of the new duplex structure steels which is intended to supplant 18:8 stainless is composed of about 21% chromium and small amounts of molybdenum, copper, manganese and nickel. The total of the alloying elements other than chromium are less than 6%. Formability and processing characteristics of the steels are still under investigation.

Low Alloy Steels

With constant pressure being imposed to find materials that use less strategic alloys, the low alloy and carbon steels are being awarded new recognition. Reluctant acceptance for some has turned to enthusiastic support when it was found that in many cases the lower alloy steels have performed more satisfactorily than the steels they replaced. However, there is seldom a case where a low alloy steel can replace a higher alloy steel without some adjustments being made.

Some of the problems which arise are:

1. Learning what heat treatments would be possible for large, intricate, non-rigid sheet metal parts.
2. Developing better welding techniques.
3. Finding satisfactory methods of protecting against corrosion, particularly at high temperatures.

For this problem cadmium, zinc and organic coatings would have to be excluded because of the temperatures. Hard plates would have to be

Needed. . . .

"A method to obtain shell - molding quality castings at sand casting prices would materially aid the development of engineering programs."

carefully investigated before adoption because many of them induce hydrogen embrittlement and reduce fatigue strength. Ceramic coatings, at least those which have been available in the past, might be impractical because of the sequence forming, welding and heat treating operations.

4. In the operating ranges of 400 to 800 F, it is necessary to consider the brittleness occurring in some steels in this range. Even 18:8 stainless and 17:7 PH steels in the work hardened condition show loss in ductility at about 500 F. Boron steels have not yet been sufficiently evaluated.

In applying certain of the low alloy steels, it was found that up to 1100 F they have the strength to withstand 2 to 3 times the loading of stainlesses at the same temperatures. This is an advantage since the low alloy steels save weight and conserve alloying elements. Again, the matter of corrosion protection has held back full scale use. Too, chro-

Needed. . . .

"We are in need of a thin metal or plastic film which may be applied by dipping or spraying. This should be impervious to water vapor as a hot dipped wax film. However, unlike wax, it must offer good adhesion to ordinary organic cements."

mium-molybdenum-vanadium ferritic steels are somewhat difficult to fabricate according to usual procedures. Steels of this class are used in several forms in jet engines.

Original cost of these materials is less than the steels which they replace, but overall costs are somewhat higher due to coating and fabricating complications.

Conditions which must be met by steels going into compressor blades include operating at higher stresses and temperatures. For instance, in one type of equipment, stress at the root of the blade was formerly 20,000 psi. Now the stresses encountered are running between 40,000 and 60,000 psi. Temperatures are in the neighborhood of 1000 F, where creep becomes a problem. Type 403 stainless is not satisfactory under these conditions.

The service requirements can be met by high strength, low alloy steels which are suitable abrasion resistant coatings. A proprietary steel which contains 12% chromium, plus molybdenum, vanadium and several other alloying elements, including tungsten in the amount of 1% each, has been used satisfactorily, although at least one user claims the material is over alloyed and is seeking a similar steel with less alloying elements.

There have been instances of ordinary carbon steel being used to replace stainless. In one such case, for combustion chamber linings, the carbon steel has been coated with an aluminum dip coating or a ceramic. One advantage of the carbon steels is that they have 4 to 5 times the thermal conductivity of stainless; hence, stresses are relieved more easily.

In connection with low alloy and carbon steels, two suggestions for improved properties would probably be echoed by many industries. One steel fabricator would like to see a better drawing quality of sheet steel that does not work harden readily. His objective is a steel that can be drawn several times without the need for annealing and subsequent pickling. If such a steel is not practical, he would settle for one which would respond to a low temperature anneal —somewhere between 200 and 500 F. Another is looking hopefully for a low carbon steel sheet as readily formable as SAE 1010, but highly resistant to ordinary rusting.

Irons

With the development of nodular or ductile irons and extensions in the use of shell molding, there has been an awakening of interest in the use of cast irons for applications where they had been overlooked. Cast iron is now being used in some aircraft applications to replace aluminum. Similar shifts can be expected in industries where high strength and economy of cast irons can be appreciated, but where low ductility had previously restricted its use.

Studies are in progress in casting technical groups as well as by individual companies and industries to learn more about the casting of irons. Many qualified observers feel that there has never been a proper evaluation of the strength properties of cast metals. So, as has been the case

Needed. . . .

"When will titanium be available at reasonable low cost for commercial use instead of restricted use?"

with other metals, there has been considerable overdesign of parts made of iron. It is almost certain that when more basic design information is known, engineers will be able to use cast iron in thinner sections and thereby reduce weights of parts. Weight reduction will, of course, permit cast irons to adjust to the trend towards high strength at lower weight in all types of products.

In one of the first aircraft conversions from aluminum to iron, nodular iron is being used to make motor mounting rings for some planes. Manufacturing economy and efficiency were both attained through the change, according to early reports. Irons might be the answer to a need for a cast ferrous material to be used in making radial inflow turbine wheels for Diesel engine turbochargers. The application requires high strength at high temperature.

The success with nodular iron has caused some materials people to dream about the possibility of a material that is most closely allied to steel that would be castable and retain its carbon in the form of floating graphite. The material would be, in effect, a nodular steel. Evidently the desire is to have a more ductile steel casting material.

Makers of electrical transformers would like to look forward to the day when they could get irons with preferred orientation, such as are obtainable in the silicon steels. The irons would have higher flux density, which would be desirable, though electrical losses would be higher.

One other desire probably covers the majority of users of both steels and irons. There is an urgent need for extremely inexpensive methods of coating materials in both these groups to protect them against most mildly corrosive conditions, such as are encountered in ordinary industrial atmospheres.

Finally, even though progress has been made in the field, there appears to be a continuing need for simple, inexpensive and satisfactory methods of repair welding ordinary gray iron castings. Several methods have been advanced in recent years, but the ideal solution has not yet been found.

New Demands

Lead to

New Directions

In Engineering Materials

Aluminum and Magnesium

In the minds of engineers in the aircraft industry and other industries striving for the lowest possible weight in their products, aluminum and magnesium still appear to be the best immediate hopes. This situation persists even though all are aware of the promise of titanium. Of course, aluminum and magnesium cannot be considered for the extremely high temperature applications for which better materials are sought, but there are many more places where these metals can be used if their properties are improved somewhat. Some predict that aluminum will continue to be the most important metal for aircraft for the next 10 to 20 years.

Before the materials can take on some of the jobs for which they are being considered, much more must be known about the properties and behavior of each under anticipated conditions. Engineers are talking about using these materials up to about 650 F. It is true that certain alloys can now withstand temperatures approaching 600 F, but there are other obstacles barring their use.

Needed. . . .

"Purification of materials to make electronic components more reliable. We understand that in England they have purified aluminum by 0.001% and that change has increased the shelf life of their electrolytic capacitors by a factor of 10. Also, their metallized - paper capacitors are far superior to ours."

More must be known about all common properties of the light metals when used over a temperature range of from -60 F to 600 F for short and long time periods to permit proper design. The need for this information is particularly great in castings. Most of the property studies have been made on the wrought materials, but the information developed does not necessarily apply to the cast products. Among the specific knowledge wanted is the modulus of elasticity of the materials under transient temperature conditions; more realistic design factors; endurance limits under repeated loads of short duration; and, the effect of temperature on vibrational characteristics. Presently accepted values for these properties in both metals are considered to be much too conservative.

Aluminum also can look forward to much greater use in electrical applications if and when better welding and soldering techniques are developed. The cost and supply situation being what it is in copper, many manufacturers would like to shift completely to aluminum for many common uses.

An often expressed desire is for titanium, aluminum or magnesium alloys offering tensile strengths of from 30,000 to 40,000 psi in sheet form at temperatures up to 600 F. Such alloys should be as readily formable as 61S aluminum and weldable by both fusion and resistance methods. The high temperature strength would be required for periods ranging from 30 sec to 1 hr for some uses and for longer times for others.

Many new alloying combinations are being tried with both aluminum and magnesium bases. Greatest hope is for alloys involving the use of the rare earth metals or in combinations of these metals and zirconium. In most cases addition of these alloying elements has resulted in improved

high temperature properties, although in some instances the improvement has been at the expense of room temperature properties.

Aluminum

Better aluminum properties are being provided by two widely variant approaches. One development which is still cloaked in some secrecy is the production of aluminum sheet by rolling sintered aluminum powders. SAP, as the material is known, has excellent elevated temperature properties. The big drawback, at present, is the fact that SAP is not weldable by any of the methods now in use. Another obstacle to extensive use of this material is its high cost. Of course, considerable research is being carried on to solve this problem.

When aluminum is alloyed with up to 13% rare earth metals, the product has good properties up to between 600 and 700 F. However, unless some modification is found, the material will probably not find extensive use. These aluminum alloys are too brittle at room temperature to be used extensively.

Among the specific improvements sought in aluminum, the following seem to be the most urgent. There is need for a weldable high strength aluminum alloy. The currently used 61S is weak in the welded condition, having a strength about equal to an annealed SO temper. The alloy needed is one in which not too much

strength is lost when welded. Such a material would be useful for large structures where the parts are too large to be reheat-treated after welding. The desired alloy would be of the precipitation hardening type. As a part of the problem there is also a need for a welding filler metal having deposited properties equal to the material being joined.

As indicated often throughout this report, more must be known about most materials before they can be used ideally. In addition to the general properties listed previously as applying equally to both aluminum and magnesium, there are several which arise primarily in connection with aluminum. For example, it is important that we know more about fatigue strength, stress rupture strength and creep strength of 14S and 61S forging alloys in order that directional properties might be evaluated more accurately.

Materials are needed for rocket nozzles that will withstand the erosive effects of high temperature gases.

Makers of Diesel engines see two important developments in aluminum to help them solve problems peculiar to their needs. There is a demand for a better aluminum alloy for Diesel engine pistons. The alloy must have high fatigue strength at 500 to 600 F. The other specific problem is in connection with bearings. An aluminum alloy is sought that can withstand higher temperatures than present alloys. In addition, the alloy should have a greater tolerance for dirt.

Some potential users are asking for better elastic properties in aluminum alloys to provide greater rigidity in structural applications, particularly when thinner sheets are used.

The wear resistance of aluminum has long been a problem and one to which an entirely satisfactory answer has not yet been found. Chromium plating has been used for some types of applications with moderate success. Chemical conversion coatings are also used extensively. What is most sought is a surface or local hardening process. Many aluminum parts have only small areas which must be protected against wear. If some method could be found to treat only these areas, it would be of immense value.

As with most materials, there is a strong and constant demand for better casting methods. The big objective is to obtain castings that are free of distortion. Some of the newer casting methods have come close to solving the problem of dimensional accuracy and smooth surfaces, but the distortion problem still remains.

Many types of coatings are being asked for in connection with aluminum alloys. One such request is for an alloy that is easy to coat with a sulfuric acid anodizing treatment and which can be impregnated with a dye coating. A coating that would probably be more of a blessing to users of aluminum alloys is a brush-on type of anodize finish to give additional corrosion protection. In many instances, parts must be altered or repaired after the original finish has been applied and the unit is assembled. A finish of the type cited would eliminate the need for disassembly or resurfacing of the entire part to protect a small area.

An example of the type of problem encountered with aluminum alloys at high temperatures is in the

manufacture of airplane de-icers. The equipment must operate at temperatures of 250 to 400 F. The first aluminum alloy used was 75S. The high temperatures caused over aging of the material and resulted in reduced corrosion resistance. The most practical answer to the problem seemed to be the replacement of 75S alloy with 24S, even though heavier sections had to be used.

Magnesium

Most of the problems which apply to aluminum and its alloys are duplicated in the case of magnesium alloys, but there are a few which apply only to magnesium, or vary somewhat when magnesium is considered.

In the case of the constant search for better high temperature properties, the most likely alloys are those in which cerium and the rare earths are the alloying elements. Such alloys have adequate strength at elevated temperatures. These alloys do need, however, new coating materials to give better corrosion protection at the contemplated temperatures.

The older magnesium alloys, such as AZ63, were once satisfactory for aircraft nose housings and other parts where the temperatures did not exceed 250 to 300 F. A few years ago, the rare earth alloys moved the temperature ceiling up to about 500 F. Now the British have an alloy of magnesium, thorium, zirconium and zinc which extends the range to 600 F. All of these temperature ranges are based on a stress of about 2,000 psi. The low strength level is satisfactory, because the section thicknesses of the parts are determined by casting techniques and limitations. The latter alloy will probably find use in compressor casings and bearing supports. For better corrosion protection at elevated temperatures, the magnesium is painted with suitable chemical surface treatments.

Several groups are working for better abrasion and wear resistance for magnesium alloys. The Army Ordnance Corps has recently released information on its HAE coating for magnesium, and other interested groups are developing similar coatings. Critics of the coatings say that they have not yet been properly evaluated. Therefore, other potential users are carefully studying the protective value of the coatings under all conditions.

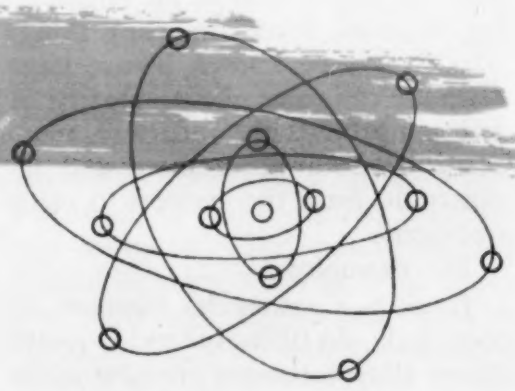
The suitability of magnesium for electric batteries has long been under investigation. During the last war some magnesium wet batteries were used with varying degrees of success. Now, magnesium is being used to replace zinc in dry-cell batteries. In this use, magnesium is said to provide lighter weight, greater watt-hour capacity, and about twice the life of ordinary batteries.

With so many interested parties working toward the solution of many of the problems listed in connection with both magnesium and aluminum, it is not being too optimistic to believe that the use of both materials will be extended considerably within the next decade.

Needed. . . .

"It is my opinion that one of the biggest boons to the reinforced plastic producing and consuming industries would be the development of a thermoplastic (post formable) sheet material with physical properties comparable to fiberglass - polyester, having the desirable forming characteristics of a high temperature thermoplastic. Such a material would have broader applications and could be used to advantage in fabricating structural parts with prevailing equipment, tooling and shop practices similar to those used for forming sheet metal."

Titanium



One of the big questions of today is just where does titanium fit into the scheme of things. The future is extremely clouded. The unlimited enthusiasm of a few years ago has now given way to a more realistic study of the situation. Many potential users of the new metal vow that it is destined for all types of noble tasks. Others are just as strong in their beliefs that titanium will always be a material which will only be used where a premium can be paid for its low weight-strength ratio or other highly favorable properties. Still others look for it to be something of a super stainless steel.

The aircraft industry is expected to be the greatest user of titanium for many years to come. Planners in that field believe that about 28% of

Needed. . . .

"Data on the heat treatment of cast iron, including the effect of combined carbon on the heat treatability of cast iron."

airframe construction will be of titanium by 1955, or more than 20,000 tons. However, the total production of titanium by that time is not expected to exceed 22,000 tons, which does not leave much for other uses. An aircraft industry production forum felt that 12,000 tons in 1955 is a more realistic figure. One of the biggest needs in connection with the future use of titanium is to have the metal used in as many ways as is possible so that its properties and possibilities can be determined under actual service conditions.

Production and use of figures for titanium are based on the assumption that there will be no new production developments that will increase the output, reduce the cost, or both. However, that situation could change rapidly.

Some observers expect the cost of titanium to compare with that of stainless steel within a few years. Electrolytic reduction processes are frequently mentioned as showing possibilities of reducing costs of the metal. In addition, there is said to be a modification of the Kroll process nearing perfection that uses liquid rather than solid magnesium. If and when this comes about, the price of titanium sponge is likely to come down to somewere between $2.50 and $3.00 per lb.

Present Problems

Although enough is now known about titanium and its alloys to assure its importance as an engineering material, there are many things which must be known before large scale use can come about. Dozens of research projects are underway, sponsored by both government and industry, to learn the answers to many questions.

For example:

Joining—Commercial titanium alloys lack ductility in weld joints. Many alloy variations are now under investigation. Considerable hope is held for titanium-iron alloys, using 1, 2 or 3% iron. Alloys containing like amounts of chromium, manganese or molybdenum are also being studied. Alpha alloys give promise of having good weldability.

Much must be learned about welding and brazing titanium alloys. In many instances there have been reported porosity in the welds and loss of physical properties. Those alloys having the highest ultimate strengths appear to be the hardest to weld. Thus, a compromise will be necessary to obtain the best combination of weldability and strength.

In welding pure titanium, tungsten-arc and shielded-arc welding seem to be the most satisfactory processes and can produce welds as strong as the base metal. As far as brazing is concerned, thus far pure silver seems to be the best material. That brazing material produces a ductile alloy. However, research on using high nickel alloys is under way and indications are that they might be satisfactory.

Aging—Aging is reported to be a problem in connection with titanium. Some students of the material claim that it becomes brittle during long storage periods. Although the exact reasons are not known, it is believed that hydrogen is a big factor.

Scrap Recovery—Thus far, no method has been developed for recovery of titanium scrap. Until some recovery can be made, there is an important cost factor which must be considered. Because of this situation, there will probably be increased importance attached to the developments of casting processes for forming titanium. Some progress has been made in casting small parts of titanium in processes which can be described as variations of the permanent mold and investment casting methods. The affinity of titanium for gases of all types, of course, makes casting of the metal difficult by ordinary methods.

As to properties, these seem to be the greatest needs according to present information.

High Temperature—Currently, titanium is being considered for use where temperatures will reach no higher than 800 F. However, it is desirable to use the metal at higher temperatures. A single phase alloy is being developed which uses aluminum as the major alloying constituent. This alloy gives promise of extending the safe temperature limit to about 1000 F.

Strength—Even at current strength levels, it is often necessary to over design with titanium, because of the variation in strength from lot to lot. Too, the fact that the properties have not been definitely determined makes over-design a common practice. Some potential users say that titanium sheet, to attain maximum use, should have tensile strengths of from 150,000 to 180,000 psi and also have good formability. Strength is now available, but formability is far from good. In this regard, aircraft builders could use titanium fasteners in large quantities immediately if there were available high strength alloys. This one change alone could save up to 1000 lb per airframe in large planes.

Corrosion Resistance—At present the corrosion resistance of the titanium alloys is the greatest selling point of the material. The current high price is holding back its use on all kinds of ships, where there is a great desire to take advantage of titanium's outstanding resistance to the effects of chlorides. There appears to be a large potential market for titanium alloys in heat exchanges, particularly in applications where brackish water is expected.

The Future

If and when the production of titanium reaches the point where important conversions can be made to the metal, it is likely that it will become a strategic metal and be subject to military allocation. Some military items are now on the verge of being converted to titanium. One example is the mortar base-plate under development by Army Ordnance. In this case, portability is a big factor.

With the greater numbers of producers and fabricators entering the field, it is certain that more use experience will soon be gained with titanium. When facts are clearly determined, a more realistic approach can be taken in use of the material. Too, there is a better than even chance that the means will be found to reduce costs of extraction and fabrication. When this happens, many who have looked favorably upon titanium will actually try it. Many of these experimental uses will become permanent.

In summary, it would appear that titanium has a great future before it. Aims of its sponsors are to bring it down into the price range of the stainless steels. These same sponsors are far from pessimistic. They point out that within about five years, they have done with titanium that which took over 25 years with aluminum.

New Demands Lead to New Directions In Engineering Materials

Other Metals

Vanadium

Zirconium

Molybdenum

Chromium

Strontium

Hafnium

Platinum

Germanium

Industry in looking for new and better properties in engineering materials, first investigates the older materials. If these do not provide the required properties, it is only natural to look to the newer materials to see if they can fill the bill. So this is why the newer metals are now being examined carefully to learn more about them and find how they are likely to withstand the conditions being imposed by modern engineering developments. The term "new" is misapplied as far as the names of many of the metals are concerned, for they have been used as elements in alloying for a long time. However, as metals alone, they are new.

Even some of the well established metals are being subjected to improvement, or are being restudied to see if they can be made to provide improved properties. Shortages, either real or apparent, in certain metals make necessary some conservation measures and require that replacement materials be found. Nickel and copper are two of the major materials for which replacements are being sought because this country is dependent upon other countries for the largest share of its supply. Columbium and cobalt are also uncertain as to supply.

Among the metals with which we have been acquainted for a long time due to their use as alloying elements are molybdenum, chromium and vanadium. Now all of these metals are being produced in relatively ductile form, and some of them are being seriously considered for some of the difficult applications for which materials must be found. In addition, there are several comparatively new names which demand attention in the field of metals.

Molybdenum is being considered for many high temperature applications, although many investigators feel that any extensive use is between 5 and 10 years away. It is believed that molybdenum will be capable of withstanding temperatures of 1800 F for long periods of time and even higher for short periods.

However, before molybdenum can be used extensively, two major problems will have to be solved. First, the element in metallic form is not sufficiently ductile for ease of forming, although this drawback does not seem impossible to overcome. The answer will probably come through alloying. The chief problem, today, is the coating of molybdenum to prevent its vaporization at high temperatures. Ceramic coatings have been tried, but are not too satisfactory, because any break in the surface will allow the metal to vaporize. Cladding now seems to be the closest answer to the oxidation problem. Nickel cladding has proved reasonably satisfactory.

High purity molybdenum can be produced which is relatively ductile at room temperatures, but at present the cost of the process is too high. Silicon, chromium and nickel-chromium alloys are now being tried to improve ductility. Ductility in welds is another poser which will hold up the use of molybdenum for a while.

As soon as some of the current problems are overcome, it is felt that many tons of molybdenum could be used immediately in jet engines for service up to 1800 F.

Chromium is now available in the metallic state, but it too lacks room temperature ductility. Active investigation indicates that it will be at least three years before chromium will be used to any great extent for structural parts.

Needed. . . .

"Temperature stable materials. We are particularly interested in learning more about the temperature stable materials; that is to say, materials with low temperature expansion coefficient and/or negative coefficient expansion material."

Vanadium was developed in relatively ductile form a few years ago and it too will probably find application in the near future. The uses of vanadium, as with the other new metals just mentioned, are restricted on the basis of room temperature ductility. The properties are better at high temperatures in the range of 1290 to 1650 F.

Some vanadium alloys have equalled molybdenum in high temperature tensile strength. At high temperatures vanadium fails through a catastrophic oxidation, forming V_2O_5. By alloying and developing a ternary system, it is thought that the temperature at which the material fails can be increased to 1650 F.

Zirconium is another of the newer metals which is expected to find considerable use in future years when there is a sufficient supply to meet the needs of the Atomic Energy Commission and still leave some for other types of applications. The largest potential application other than its uses in atomic energy for zirconium is to handle corrosive media of all kinds. At the present stage of development, corrosion resistance seems to be the outstanding property of zirconium.

The microwave industry could find many uses immediately for small tubing made of molybdenum, tantalum and tungsten. The tubing needed should be from 0.075 to 1.000 in. in dia, with wall thicknesses of from 0.005 to 0.025 in. with tolerances of from 0.001 to 0.003 in.

Frequently mentioned in recent months is rhenium, which seems to have many properties that are of interest to the electronics industry. Rhenium is more abundant than

many metals of the platinum family, but is costly at the moment. Currently, the material sells for $2 per gram, but the price will come down when sufficient demand develops. In the early stages of development, rhenium was thought to be lacking in ductility, but recent reports indicate that ductile forms are now being produced in sheets, tubing and crucibles.

Of course, germanium has attracted considerable attention during the last few years for its unique electronic properties. As it moves into actual applications, there are already other materials which are less expensive and more easily found which might supplant germanium even before it gets well established.

Strontium is another new metal which will find limited application through its unique properties. Strontium 90 is a radioactive material that emits no gamma rays. It has a life of from 25 to 50 years and is not dangerous. Strontium emits light in absolute darkness with an intensity sufficient to permit the reading of large print a few inches away. The material glows with various colors, which depend upon the impurities in the zinc base from which it is made. One early indicated use is in Naval personnel markers.

An example of the steps being taken to conserve materials is the case of cupro nickel. The standard 70/30 alloy has been replaced by one containing 90 copper and 10% nickel. The lean alloy has corrosion resistance as good as the rich alloy in many environments. The lean alloy can be modified with iron.

Along the same lines there is a need for a substitute to take the place of the 18% nickel silver. The replacement material should use less nickel than the standard alloy but not suffer any loss in properties. In other words, the new material must be as strong, ductile and corrosion resistant as the 18% nickel material and also retain the white color. The material would be used in making cutlery and dinnerware.

Another group of needs are also expressed by those making silverware. First, there is the need for silver alloys of sterling fineness and methods of making silver and silver plate tarnish proof.

In attempts to make materials last longer, it has been found that 37 nickel, 18% chromium, balance iron alloys can be given better resistance to scaling by adding varying quantities of aluminum. Some difficulties have been found in the alloys, even with small aluminum additions. The material is hard to saw, so it is probable that new machining methods would have to be developed before large scale use develops.

Needed. . . .

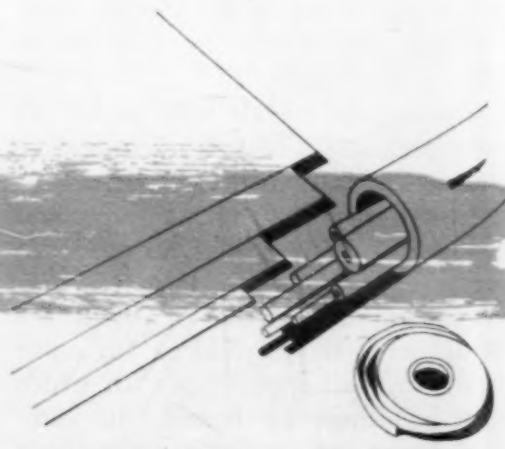
"Tougher silicon rubbers for high-low temperature gaskets, bushings, etc. Perhaps a Teflon formulation could be soft enough."

Better bearing metals are needed. Some of the needs dictate that the bearing materials be made from within specific materials groups. However, for some applications, it is not necessary to retain the specific properties of any one material. A typical demand is for a bearing material with increased fatigue strength, resistance to corrosion and reasonable imbedability but which is less expensive than silver alloy bearings.

All types of materials are being used to make hermetic seals, including glass, waxes, rubbers, plastics and metals. There is still a need for a metal to make a strong hermetic seal and be capable of withstanding humid and salt atmospheres without corroding.

New Demands Lead to New Directions In Engineering Materials

Plastics



It is accepted as fact that plastics will play an important part in the engineering materials picture from this point on. Materials in the plastics family have overcome many faults and battered down many prejudices. But there still remains much to be done if these materials are to carry the load expected of them. Where, and how extensively plastics will be used in engineering applications is a subject of extensive debate. As a matter of fact, many plastics have already earned their industrial applications despite the competition of traditional materials. They have been accepted because they have been able to prove themselves where properly selected and applied.

Some of the strongest proponents have gone on record with the claim that certain types of plastics will be the ultimate answer to the materials requirements for some of the major components of high-speed aircraft. Of course, there are as many, or more, people who feel that plastics will not be capable of the job. As in any debate of this nature, the answer probably lies somewhere between the two extreme views.

In considering plastics for structural applications, most attention is directed towards the glass-reinforced plastics. Considerable publicity has

been garnered by plastics of these types during recent months because of the announcements of several major automobile manufacturers that they are going to produce a limited number of plastic automobile bodies during the current production year. Even if these experiments are something less than completely successful, it is probable that much more valuable production information will be developed due to the fact that so many more engineers will be devoting their attention to methods of forming, joining and finishing. Also, with such a valuable market as the automotive and aircraft industries opening up to them, manufacturers of resins will be spurred to produce material which appear to be necessary to provide the properties that will be needed in the near future.

Those engineers who think highly of the future of reinforced plastics can cite many valuable properties to be found in them. Among their properties are the ability to resist atmospheric and water corrosion and the destructive effect of many chemicals; good tensile strengths, comparing favorably with mild steels; extremely high impact resistance; and, the fact that raw materials from which they are made are practically inexhaustible.

Those who are doubtful about the use of reinforced plastics as structural materials have good grounds for their doubts, but the points they raise are not such that they should serve as a permanent barrier. Even the doubting Thomases will admit that in the far distant future, there might be a place for these materials in structural applications.

It is admitted that there are many things to be learned about plastics, but the same can be said for many other engineering materials. It has been pointed out that reinforced plastics have not yet been comprehensively tested at terrifically high speeds. For example, it has not been fully tested at Mach 2.5. Too, the stress areas which require study for plastics applications are still undefined and the available materials have not been completely explored. Summarizing the attitudes of those who are not completely sold on plastics yet, it might be said that plastics must still be considered as experimental materials which can be classified as possibilities for the distant future.

Two factors which might have a bearing on the use of reinforced plastics are the costs of raw materials and of fabrication, and the difficulty in joining them to similar and dissimilar materials. Coating for decorative purposes is also a slow process, as compared to coating steels.

Regardless of where plastics are to go in the future, the reinforced plastics as well as other types of plastics are already being used for many engineering applications. In addition to the reinforced plastics, nylon plastics and the fluorocarbon plastics are being used extensively. Many other resins are being used in important joining applications.

Having sensed valuable properties in plastics in the present state of development, many engineers are asking for various improved properties to meet the particular problems that face them.

Needed. . . .

"A test or method for evaluating the qualities of brazed joints, having in mind the control of factors such as joint thickness that are important variables".

Reinforced Plastics

Based on the successful use of plastics in small boats, the Navy decided to make small assault boats of reinforced plastics. The plastics boats have proved so satisfactory in lengths up to 42-ft long that the same materials are being considered for boats up to 100-ft long. Plastics boats can be beached in places where metal boats would not survive, primarily because of the impact strength of the plastics. If minor tears or breaks should occur, they can be repaired quite easily.

In the U. S. Army Signal Corps, all plywood masts are being replaced by glass-fiber polyester plastics materials. Small housings and protective covers for many types of equipment are made of the same materials. Admittedly the materials are expensive, but the long life and ability to withstand hard usage without losing shape are important assets.

For immediate aircraft use, radomes made of reinforced plastics are being studied for use under conditions involving up to 30-lb external pressure.

Future needs of industry can be met with resins or binders that will resist the high temperatures which would be encountered on aircraft surfaces which will travel at several hundred miles an hour. At extremely high air speeds, the heat generated by friction is expected to reach about 400 F. The best resins now in use are not suited to continuous service at temperature above 250 F.

Possibly the answer to the high temperature problem will come through some new resin which has higher temperature limits or through a variation in some of the present high temperature resins. Phenolic resins are now being tried. On the other hand, it might be necessary to develop some inorganic binders which meet the best properties of the polyester resins and are capable of maintaining their strength properties at high temperature levels. In England, asbestos fibers have been used in place of glass fibers for better heat resistance.

An interesting industrial need for plastics might be met by reinforced plastics. A tractor manufacturer is interested in finding a sheet plastic material that is capable of forming in the same manner as sheet metal. The material would be used to make radiator equipment for farm equipment. The part is louvered and backed up with screen mesh to protect the radiator cores from insects and other foreign matter. Glass-reinforced plastics would seem to be the most logical material for the application, possibly with an integral nylon mesh screen, but as yet no supplier has been able to produce a satisfactory sheet.

Resin Adhesives

The British are using resins for the majority of joining applications in the new Comet jet airliner. Resin adhesives have been used to replace rivets in the plane. Engineers responsible for the plane say that if rivets were used in place of adhesives, the craft would be too heavy to carry any payload without a major redesign.

There are several advantages in using adhesives in place of rivets or other mechanical fasteners for plane wings and fuselages. One of the most important is the elimination of uneven surfaces which disturb the air flow over the plane's surfaces. Too, rivets act as stress raisers when used in parts that are subject to intense vibration. On test pieces which have been bonded and riveted, the riveted joint has failed before the adhesive.

Needed. . . .

"We are looking for materials which will stand up in 400 to 700 F water, or steam at even higher temperatures, without excessive corrosion."

Although resin adhesives are used for many applications in the United States, they have not been applied widely yet in aircraft manufacture. The major use up to this time has been in helicopter rotors where vibration is a serious problem. The materials engineering departments of most aircraft companies are giving serious study to adhesives, and many of them are on the verge of accepting high strength, high temperature adhesives.

Foamable Plastics

Within the last few years several new foamable plastics have been developed, and it is understood that several others are nearing the commercial stages. The ultimate uses of castable foam plastics are just beginning to show themselves. Many predict a highly favorable future for plastics of this type. One of the first uses of foaming plastics is in aircraft, where they are used to fill sheet metal structures such as control surfaces. Foamable plastics used in this manner permit substantial reductions in fabricating costs of many assemblies and result in important weight savings without sacrificing strength. The density of most of the foaming materials can be varied through using different formulations.

Those who anticipate large scale use of castable foam plastics see the materials replacing balsa wood and sandwich materials in many structural applications. The newer materials are lighter in weight, have good strength, and are much easier to fabricate. The materials currently available are limited to top temperatures of about 300 F. Now engineers are asking for similar materials that will be useful up to about 500 F. To achieve that goal, new resins must be developed for the glass fiber skin and the foam core.

For other applications, castable foam plastics are sought which are more durable, tougher and firmer. Also, it would be helpful if the plastics could be cured quickly at room temperature. The plastics would be used in metal containers and panels for their insulating properties.

Other Plastics

Plastics of types other than the two groups discussed are used in widely divergent fields. Phenolics, both plain and reinforced, laminated plastics, and now nylons are being used for many mechanical parts where quietness of operation, good impact strength and corrosion resistance cause them to be favored over metals or other nonmetallics. In mechanical applications, plastics are sometimes used alone and sometimes in conjunction with metals. An example is in the use of nylon gears. When the gears are to operate at low speeds, nylon is used against nylon; at high speeds, nylon against steel.

In the broad field of plastics materials, there are many improvements in properties which would appear to be necessary to permit further product development. At least the engineers charged with developing many products are looking among the plastics materials for the needed properties.

Here are some of the needs they have expressed:

Better electrical properties in post-forming phenolic materials. In addition, better post-forming techniques are wanted.

A plastic to replace stainless steel, monel and hard rubber for making pouring spouts used in food handling equipment. The materials should be machinable and able to withstand all liquid foods and chemicals.

A post-formable sheet plastic material with physical properties comparable to those of the glass-reinforced polyesters, and having the desirable forming characteristics of the high temperature thermoplastics. The material should be capable of being formed by the same methods as are used to shape sheet metal.

A material for the electronic industry of the fluorocarbon type which retains the same electrical and physical properties, but which has extended upper and lower temperature limits.

A clear plastics material with a temperature range of approximately —67 F to 160 F. The material would be used inside a hermetic seal and the temperature would not affect the material's properties

A castable plastics material which has relatively high insulation resistance, but still higher heat conductivity than has been achieved by casting resins which are impregnated with metal particles.

A plastics hose that is flexible and chemical resistant.

Better laminated plastics for the radomes on aircraft that now must be protected by neoprene. The new plastics would be able to withstand the erosive effects of rain without any auxiliary coating. For the same type of applications there is some demand for clear plastics that will stand the weathering and rain conditions involved. Also wanted are better coatings which will dissipate static charges that build up on radomes.

A resin or binder which can be used for molding sawdust and shavings into strong, tough articles that would have strengths comparable to wood.

Needed. . . .

"A metal which can be economically hardened to give the extreme abrasion resistance required in the design of pumps to handle abrasive fluids."

Needed. . . .

"We need an economical process for coating cast iron and malleable iron valve bodies, etc., to protect against corrosion in fresh water service. We do not look with favor on vitreous porcelain enameling, due to the cost and difficulty in machining after enameling. Hot-dip zinc galvanizing is also objectionable, due to machining difficulties and the galvanic couples set up between the zinc coating and brass fittings which are assembled into the valve body".

New Demands
Lead to
New Directions
In Engineering Materials

Other Nonmetallics

Ceramics
Glass
Rubber
Fibers

There have been many improvements in nonmetallic materials other than the plastics, but as with all other materials, still further improvements are desired. There is no type of nonmetallic material normally used for structural applications in which there are no requests for improvements. Some of the more persistent desires will be discussed here.

Ceramics

Ceramics in several forms are attracting much attention, primarily for their ability to withstand high temperatures. Ceramics are being used as solid material, as coatings, and in conjunction with metallic elements in the so-called cermets.

Turbine blades and many other structural parts could utilize the high temperature properties of ceramics if only the materials could be made more ductile. The brittleness which is a definite characteristic of ceramic materials restricts their use, because considerable damage could be done in high-speed equipment if something should cause ceramic parts to break. At the same time, brittleness creates difficulties in fastening and holding ceramics parts.

In using cermets, most systems have been of a three-phase nature which involved a metallic element, a ceramic, and a bonding agent. Attempts are now being made to develop satisfactory two-phase systems. Alloys are being tried in the metal phase. In the two-phase system, bonding is achieved by the structural arrangements of individual particles. In the early cermets, metallic oxides were used; but now experimentation involves the use of borides, silicides, carbides and nitrides.

It is possible that some of the new developments in cermets will revive the optimism felt for that type of material a few years ago, but which has waned recently. Brittleness and the failure to find satisfactory fastening methods have caused some of the loss of interest in cermets.

Oxides combined with metals—which are not considered to be cermets—are creating some interest. There are many investigations being carried on to investigate the uses of such materials, with particular attention being paid to the sintered aluminum powders. According to European sources, the SAP materials have much to offer, particularly higher temperature applications. Massive sintered powder shapes can be rolled to provide sheet materials.

Some ceramics are finding extended use for machine parts involving abrasion and corrosion, but no shock loading. The biggest obstacle to increased use in this area is the difficulty encountered in making parts to extremely close dimensions.

Rubbers and Elastomers

There is a serious need for rubbers which are usable at temperatures ranging from —65 F to 500 or 600 F. The rubbers must also be capable of handling aircraft lubricants based on esters, hydrocarbons and similar products. All rubbers now available are attacked by these materials. Other rubbers are sought which will meet these specifications and also be resistant to high temperature acids, such as the fuming nitrics, and be compatible with 90% hydrogen peroxide.

Another synthetic material is desired which has the resilience and strength of synthetic rubbers, such as neoprene and Buna-N, and is able to handle solvents such as acetones and lacquer thinners.

There have been interesting developments in silicones and silicone rubbers which have resulted in increased strength, elasticity, temperature range and abrasion resistance, but even better properties are desired. For example, there is a need for silicone rubbers that are many times tougher than those now on the market. These materials would be used for high temperature gaskets and bushings.

Needed. . . .

"Development of an aluminum bearing material for Diesels that can withstand higher temperatures and more tolerant to dirt than present aluminum alloys."

Needed. . . .

"A good bearing material with increased fatigue strength, resistance to corrosion, and reasonable embedability, but less expensive than the silver alloy bearings."

Glass

Glass is coming into prominence as a possible material for some structural applications. It is felt that some metals could be replaced if it were possible to get some glasses with better structural properties. Many new properties have been built into glass during recent years, so it is not impossible to expect stronger, less brittle and more formable glasses sometime in the future.

There is a need for a glass mat which could be combined with melamine or silicone resins and formed into boards as thin as 0.015 in. to replace the fine weave glass materials now used. Such a material would be considerably lower in cost than the present materials.

Other Materials

A material is sought to replace silicone compounds in conducting heat away from vacuum tubes. The material sought would have a viscosity such that it would be nonpourable at temperatures from 70 F to 250 F and would have greater heat conductivity than the silicones.

Also needed is a synthetic fiber with characteristics similar to asbestos, particularly in respect to the ability of asbestos to be divided into extremely fine fibers.

New Demands Lead to New Directions In Engineering Materials

Coatings and Finishes

Now, as for many years in the past, coatings and finishes of various kinds are being relied upon to make up for some of the shortcomings in the metals upon which they are used. Of course, some finishes are used for decorative purposes only, but these are not of great moment as far as engineering progress is concerned. Basically, the problem is to protect materials with other valuable attributes against their common desire to oxidize under certain conditions. However, there are other features which can be provided through coatings, as for example, wear and abrasion resistance.

Today, many metals are being asked to withstand the destructive effects of temperatures that are much higher than those to which the materials would normally be subjected. The temperature problem is foremost in connection with the improvement of jet engines, but it does exist to a smaller degree in many other materials applications. Many metals have the required strength at the high temperatures reached, but they will not last long in the presence of air. Thus, they must be protected. Various approaches are being taken to provide this protection. At the lower temperatures, paints and mixtures of organic substances and metallic powders are used. At the upper temperatures, ceramic coatings seem to be the best possibility for protection.

Coatings must be provided for other reasons. For example, rain drops are highly destructive to airplane parts which pass through them at high speeds. Rubber-like coatings can be used to protect them. In other cases, some of the newer synthetic materials have excellent resistance to chemical corrosion, but are almost too expensive to use in large scale applications. Thus, methods of using sheets or films of the materials are sought. The same is true of some of the newer metals. If they could be used as extremely thin plate over less corrosion resistant materials, many industries would benefit.

At best, coating is an expensive operation, and industry would just as soon eliminate it. This seems to be impossible, so it is important that the coatings which are applied be simple to apply and permanent. Much research is being directed toward that end.

Ceramic Coatings

During the past few years we have heard an increasing amount about the use of ceramic coatings to extend the useful temperature range of steels. Although the present materials have been reasonably successful, there have been certain shortcomings. One of the big drawbacks has been the brittleness of the ceramic coatings. Another is the fact that rather thick coatings had to be applied. Finally, the use of ceramic coatings involves an additional heating cycle which is costly and time consuming. Even with these shortcomings, several of the ceramic coatings being used have permitted the use of low carbons and low alloy steels for applications which would normally call for stainless or other high alloy steels.

Some users even go so far as to state that carbon steels coated with ceramics or a dipped aluminum coating are superior to stainless steels for such applications as combustion chamber linings. Carbon steels have 4 to 5 times the thermal conductivity of stainless, hence stresses are relieved more easily. In some cases, the supposedly backward step from stainless to the extremely low alloy steels provided results that were much superior.

Recently developed is a new ceramic coating that gives promise of overcoming the shortcomings which have been charged to the currently available ceramic materials used this way. Details of exactly how the new coating works have not been revealed, but the developers say: "The new ceramic coating has no glass matrix, but achieves bonding by a complex structural combination akin to a solid solution." It is believed that the new coating is satisfactory for all applications now using high temperature enamel coatings. The material follows the trend away from the use of bonding agents, which seems to be the weakest link in the applications of ceramic and refractory materials.

Characteristics of the new coating are said to be:

1. It will withstand temperatures up to 3000 F. The coating has high reflectance, and thus low thermal conductivity—adding further protection to the material it coats.

2. Ultra-thin coatings can be applied and still give adequate protection. The thin coatings provide improved shock resistance. Coating thicknesses of from 0.001 to 0.0005 in. are sufficient.

3. The coatings have low porosity. The pores are so small as to exclude oxygen on the basis of physical dimensions alone. Thus, good corrosion resistance is expected.

4. The ceramic coating is easily applied by spraying the part to be covered or dipping it in a water solution of the coating. Curing is achieved at a temperature below 1000 F.

5. Cost is said to be equal to that of other present day high temperature ceramic coatings.

Chief use of the coating is expected to be that of protecting low cost metals in high temperature service. If this new coating meets all of the claims made for it, it will have gone a long way toward simplifying the problem of using ceramic coatings, and will eliminate many complaints against the present coatings.

The abrasion resistance of ceramic coatings might not be high enough to permit their use on jet engine

compressor blades. But on the parts where such coatings are used, there is another advantage in addition to their providing high temperature protection. Compressive stresses which result from the coatings are said to improve the fatigue strength of the part. Too, the coatings lessen vibration and dampen sheet metal.

Paints

Although some people refer to ceramic coatings as merely high temperature paints, no paints could be used at the top temperatures contemplated for the ceramic coatings; but they are used to protect some metals at lower temperatures.

Mild steel is being coated with a silicone-aluminum material which prevents the steel from discoloring up to 1000 F. With the same coating, stainless can be used up to 1600 F without changing color, or showing signs of oxidation. The coating does not provide too much protection against abrasion. At present we do not know how long the coatings will withstand high temperatures, as they have only been tested for periods of a few hours. Both magnesium and steel are being protected up to 600 F by various high temperature paints.

Plastics Coatings

Many engineers are looking with great hope to the various resins in their search for better resistance to corrosion. Some of the coatings would be in the form of sprayable materials and others would be used in sheet or film form. Most of these developments are in the future and include such forward steps as these:

There is sought a thin metal or plastic film that could be applied by dipping or spraying. The coating would be impervious to water vapor, but unlike wax, offer good adhesion to ordinary organic cements.

It is possible that some of the newer resins will be used in films for protecting metal surfaces. Such films might permit thinner layers of coating.

It is hoped that within the near future, the fluorocarbon plastics will be available as better spray coatings which can be easily and inexpensively applied. The materials are now too expensive for many uses, and there are no known adhesives to bond films of the materials to other surfaces. These plastics are remarkably inert to most chemicals and solvents, so if they could be used more widely, less expensive metals could be used for highly corrosive conditions.

Plated Coatings

The art of plating remains pretty much that, due to the fact that more knowledge must be developed about the process. The effect of plating on many alloys must be known and more information is needed on plating formulas and on the characteristics of the plated deposits.

A forward step in plating has been taken recently in the commercial development of a chemical process for nickel plating of most metals as well as glass and plastics. On the basis of early use, the chemical plating process deposits a nickel compound that is remarkably free of porosity and which has good resistance to wear.

This development is in the direction outlined by many people who seek better, easier and less expensive plating methods. These same people are asking for a great deal more. One of the better dreams for the future is that there will become available a method for plating any metal to any other. When this arrives, the advantages of titanium, zirconium, molybdenum and other remarkable metals can be used more widely, and at lower cost than would be involved were solid parts of the metal used.

The plating of base metals with chromium-base alloys is under development now. Major obstacles yet to be overcome are porosity and brittleness in the deposited alloy.

Other Finishes and Coatings

There is a definite need for a hard surfacing treatment, much like chromizing, which can be applied at temperatures of from 800 to 1000 F. One place where such a process could be used would be in protecting the linings of gun barrels from the erosive action of gases. As it is now, the barrels must be lined with some other material; for it would be unthinkable to subject expensive barrels to the high heats necessary for present day hard surfacing treatments such as nitriding.

Aluminum-coated steels have been attracting considerable attention recently as possible competitors to galvanized steels. There have been many applications, but there are some objections to the use of the aluminum-coated product. Cut edges of the steel will rust, because aluminum does not seem to give the same protection as zinc under these circumstances. The reason for this disparity is not known, for theoretically, both metals should act the same. The answer will probably be found in the near future, because of the desirability of using aluminum for longer life under corrosive conditions.

Several chemical and electrolytic coating processes have been developed to protect magnesium. Many of them are similar, but as yet they have not been properly evaluated. One of the first was developed by Army Ordnance to provide added corrosion and abrasion resistance to military items made of magnesium.

Also needed is an economical process for coating gray iron and malleable iron valve bodies to protect them against fresh water corrosion. An engineer seeking this type of coating does not like the vitreous enamel coatings or hot dip galvanized coatings for various reasons, including the difficulty in machining after the coatings have been applied. In addition, the vitreous coatings are considered too expensive for this application. One possibility for this application is some type of plastic coating, perhaps even one that would have to be baked on. Whatever the coating, it must be impermeable to water when constantly submerged.

One other coating development seems to be desirable. Many users of anodized aluminum would like a brush-on type of coating which could be used to add the same type of protection to parts which had been treated and then repaired. Many parts that are now scrapped could then be salvaged.

Akin to finishes and coatings are materials for lining metal objects to provide corrosion resistance, such as:

A material for lining vapor degreasers which are used in field applications where resins requiring baking would not be feasible. The materials must be impervious to hot dilute hydrochloric acid, impingement of hot liquid trichloroethylene and hot trichloroethylene vapor.

Linings are needed for steel hot water tanks. The materials must be economical and usable at pressures of 300 psi at temperatures up to 180 F. The material should be highly resistant to corrosion under extreme conditions, such as chlorides in water.

Another lining problem is the need for a tough, shock resistant, moderately abrasion resistant lining for pickling tanks to handle 30% phosphoric acid and 30% hydrochloric acid at 60 F.

New Demands
Lead to
New Directions
In Engineering Materials

Parts and Forms

One of the best places in which to make cost savings, regardless of the material being used, is in the manner in which the desired part or form of the material is achieved. Machining is expensive with all materials, so if casting, drawing, extruding or pressing operations can produce the shapes needed, they are to be preferred. Too, some of the newer materials, or the materials being developed for high temperature applications, are not readily machinable and must be formed in some other way.

Casting and forging are the two oldest methods of shaping metal parts, and the chances are that they will maintain their importance regardless of the materials that might come along. The choice between the two methods will often depend upon the material being formed. Some metals can be forged but they cannot be cast, and the reverse is true of other metals. When either casting or forging is possible, there are now trends indicating that casting is to be preferred. Casting is less expensive when few parts are required, and now that new casting techniques are being developed, good surface finish and closer dimensional tolerances will be attained.

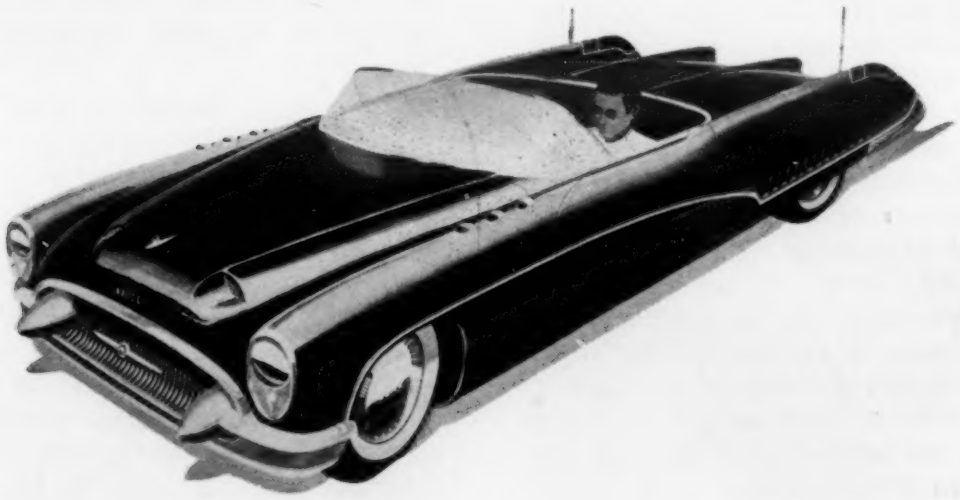
The U. S. Air Force is sponsoring what is known as the "heavy press program," but there is considerable private doubt as to its practicability. Huge extruding, forging and drawing presses are being built with the idea of making parts as large as an airplane wing in one operation. It is probably true that much labor and material could be saved by such developments, but the point is made that in the event of full scale production we would not have nearly enough capacity to meet even a fraction of our needs. Die costs would be exceedingly high for such large pieces, and there will be a scarcity of die shops capable of producing such dies. This situation existed with ordinary forging equipment during the last war.

On the other hand, casting facilities can be expanded much more quickly and for a great deal less expense. Many observers are predicting that there will be a definite trend towards casting, not only for the extremely large parts, but also for many small and medium parts which could also be made as forgings. To make this latter belief come true will require even greater refinements in the casting processes and the development of more information about the strength of casting in order that more realistic designs can be developed. There is a definite feeling today that many cast parts are overdesigned by many times. More realistic design would, of course, result in important materials savings. The casting processes have in their favor the fact that with most materials the raw materials for casting are the least expensive of those used for any forming processes.

Both hot and cold extruding are to be used more extensively. Until a few years ago, extruding was limited to aluminum, magnesium and some copper alloys. Now plain and alloy steels are being formed by extruding with considerable savings in production costs. Hot extruding of steel depended upon the development of suitable lubricants. Now various forms of glass are used for many of the processes in use, and this lubricant seems to meet the needs of today. Cold extrusion is pretty much restricted to cylindrical objects, but hot extruding can be used for odd shapes. Ways are being sought to make titanium alloy parts by impact extrusion or hot pressing.

Here are some of the most pressing problems as far as parts and forms are concerned:

There is need for a die casting alloy having wear resistance and dimensional stability close to that of cast iron. The material would be used to make complex castings re-



The automobile of tomorrow will probably make wide use of plastics.

quiring close dimensional tolerances.

Aluminum castings in large size need improved casting process. Large aluminum castings are still made in sand molds, while the same castings have been improved through shell molding. A similar process for large castings would be well received.

Considerable money could be saved in making many parts if it were possible to develop a casting process for steel that would produce parts with a finish comparable to that of cold rolled steel. That degree of finish seems unlikely by any mass production casting process, but any improvements would be welcomed.

Now that shell molding is just about established as a competitive casting process for many materials and parts, there is pressure being exerted to find ways of reducing costs. The goal would be shell molding quality and sand casting costs. Shell molding is now being experimented with in connection with the use of nodular irons. The process has proved satisfactory for most other irons and probably will be useful for ductile irons.

There is a need for bimetallic tubing which has an outside material chosen for strength and the inside material selected for corrosion resistance. Reports are that the currently available varieties of bimetallic tubing are not highly satisfactory.

Another tubing requirement is for a tubing that has a modulus of 30,000,000 psi and that is absolutely nonmagnetic, noncorrosive and as machinable as brass.

New Demands Lead to New Directions In Engineering Materials

Welding and Joining

For maximum usefulness, engineering materials must be capable of being joined to similar and dissimilar materials. Of course, bolting and riveting can be used with most materials, but the use of such fasteners can cause difficulties with some materials. When high stresses are involved in the end service, bolt or rivet holes can become stress raising points in materials that are notch sensitive. So, for many uses, welding, soldering, brazing or adhesive bonding are preferred to mechanical fastening. Mechanical fastening is by no means on the way out, but there are a few places where it cannot be used.

Each new material development carries with it the need for a different joining method. A new, stronger steel cannot be welded satisfactorily by the same methods which had been developed for a carbon steel. The methods of welding or brazing titanium must be specifically developed for the alloys of that material. Some progress has been reported in joining titanium alloys, but there is considerable divergence of opinion as to the quality of the joints.

Some experts contend that the matter of joining materials is probably the most perplexing one that we must face today. They are convinced that most of the high temperature problems now getting attention could be handled by available materials if only better methods of joining were perfected. The need for better joining starts with soldering and continues on through brazing and welding.

Even as the fusion joining methods are being pressed for improvement, adhesive bonding methods have become of increasing importance for high strength joints. Now there is a demand for adhesives which will be capable of maintaining their joint strength at considerably higher temperatures than those at which they are now used.

With an increase in the use of nonmetallic materials, needs are developing for methods of joining them permanently to other components. There is a desire to use ceramics, cermets and ceramic coated metals for turbine blades in jet engines. At present, there is no completely satisfactory method for joining such materials to the rotors. Mechanical methods are not suitable because of the brittleness of ceramics and ceramic coatings.

Here are some of the specific problems reported by engineers and researchers throughout the country:

Welding

Considerable research is being directed towards the problems encountered in welding high strength and high alloy steels. Some progress has been reported. The AEC is sponsoring extensive investigation into the welding characteristics of Type 347 stainless steel. It is reported that these investigations have already resulted in a welding rod which deposits an austenitic bead with low cracking tendencies. However, this research might not be too important in the future, as more users of stainless which must be welded appear to favor the extra low carbon stainless rather than the columbium stabilized stainless steels, such as columbium stabilized Type 347. The latter steel is often specified when Type 304 would be more satisfactory for the application.

Almost every user of metallic arc welding is asking for electrodes having the same deposited properties as mild steel. The desired rod would not only conform to the base metal as far as elasticity is concerned, but also as to yield point.

As stronger metals are developed the welding problem gets more seri-

ous. We are now having some troubles with most steels having a yield point of 50,000 psi or greater. According to the aircraft industry and the armed services, we will soon be using, or attempting to use, ultra-high strength steels for widespread applications. Some research laboratories report they have been able to make welds suitable for all applications in metals having 90,000 psi yield strength.

Indications are that the rare earth-treated steels will soon come into more common use due to the superior high temperature properties imparted by these additions. New rods and new techniques will have to be developed to weld them. The same is true of the molybdenum, magnesium and boron steels under development.

Brazing

There is a feeling prevalent that brazing would be much more generally used if more were known about the process. Likewise, better methods of determining the soundness of brazed joints are desirable. Most of the requests for better brazing alloys can be summed up in the specification that the desired alloys be applied at lower temperatures than present-day alloys. At the same time, the joint properties should be comparable to those of the higher melting point alloys.

Typical is the request for a hard silver solder which flows at 1000 to 1050 F and has the same strength and impact resistance as the silver solders currently being used, having a flow point of 1150 F. At the temperatures involved, a difference of 100 to 150 F is mighty important.

In brazing for high temperature applications, a process known as Nicarb brazing, which is done at 2100 F, gives adequate joints for service up to just short of that temperature. Brazing must be done in a dry hydrogen atmosphere. Brazed joints of this type have been used for Inconel, stainless steels and other high alloy materials. Copper brazing, using no flux and done in a cracked ammonia atmosphere, is useful for somewhat lower temperatures.

Soldering

Although most users of solders feel that there could be an improvement, most urgent requests for better materials comes from those people who are concerned with soldering aluminum.

Greater use of aluminum in electrical applications is almost a certainty when and if a better soldering method is developed. Two problems are involved. One concerns the soldering of aluminum to aluminum, and the other is needed for joining aluminum to copper.

What is really wanted is a solder that can be used in a manner similar to those solders used to make copper joints. The elimination of corrosive fluxes is the most important single element. In many joints, remnants of the flux are retained in the joint only to eat through the insulation and ultimately result in the failure of the connection.

Considerable investigation is being carried on in connection with the use of ultrasonic soldering methods. There are many difficulties which remain to be removed from that process before it can be universally accepted. Even with complete acceptance of ultrasonic soldering, there would still remain the problem of soldering aluminum in those areas where it would be impossible or impracticable to move all of the equipment required to produce the necessary ultrasonic vibrations.

Another soldering need has been cited as "a satisfactory solder melting in the range of 600 to 700 F." Such a solder, apparently, would be welcomed by many people facing touchy joining problems.

Adhesive Joining

Adhesive bonding is becoming increasingly attractive for high-speed aircraft because of the opportunities it offers for providing smoother surfaces on the exterior of the planes. The method is already in extensive use in England on such planes as the Comet. Currently, the greatest use in this country is in the manufacture of some helicopter rotors. In the case of rotors, there is a problem of vibratory fatigue which is exaggerated by the use of rivets which act as stress raisers.

The absence of a good nondestructive test for adhesive joints has been noted. Such a test is necessary to determine the quality of bonds. It is known, for example, that there are adhesives available for aluminum that are stronger than rivets in bonding aluminum, but joint quality is difficult to determine.

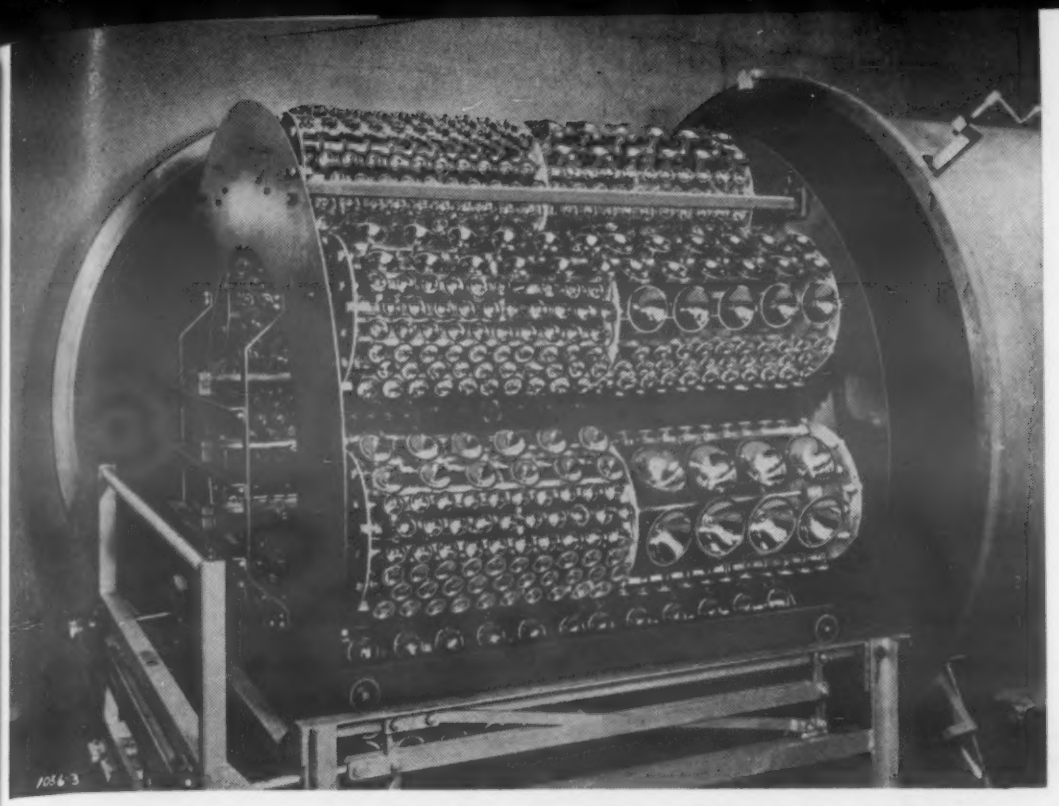
As the temperature requirements of other joining materials rise with the higher speeds and higher temperatures of aircraft, the needs for high temperature adhesives also develop. It is possible that some of the epoxy resins will prove suitable, but research is continuing with other resins. Better properties are being achieved by combining the epoxies with other resins.

Although many adhesives will set at room temperatures if given sufficient time, some require the application of heat to obtain maximum strength. At least one potential user of adhesives sees the need for an adhesive that will set to its maximum strength at room temperature and which will be satisfactory for bonding galvanized steel parts to similar materials at low temperatures.

An adhesive bonding need that has defied a satisfactory answer for some time is for an adhesive for joining the fluorocarbon plastics to themselves and to other materials. Some proprietary processes have been developed but they are not available for wide application. When a simple bonding method is used, the highly desirable properties of these materials can be used more extensively because thin films can be bonded to metals and nonmetallic parts to give them superior resistance to most chemicals and solvents. One important use would be in making gasketing materials where the chemical resistance of the plastics could be combined with the elasticity and resiliency of natural and synthetic rubbers. The adhesive, of course, would have to withstand the extreme temperature ranges of the plastics themselves and be resistant to the corrosive effects of most chemicals.

Needed. . . .

"A problem which we are currently faced with is lubricants for refrigeration machinery. This problem may concern mineral oils and/or synthetic oils, and our problem deals with increasing lower temperatures and attendant higher compressor head temperatures, both when used with the Freon and ammonia types of refrigerants."



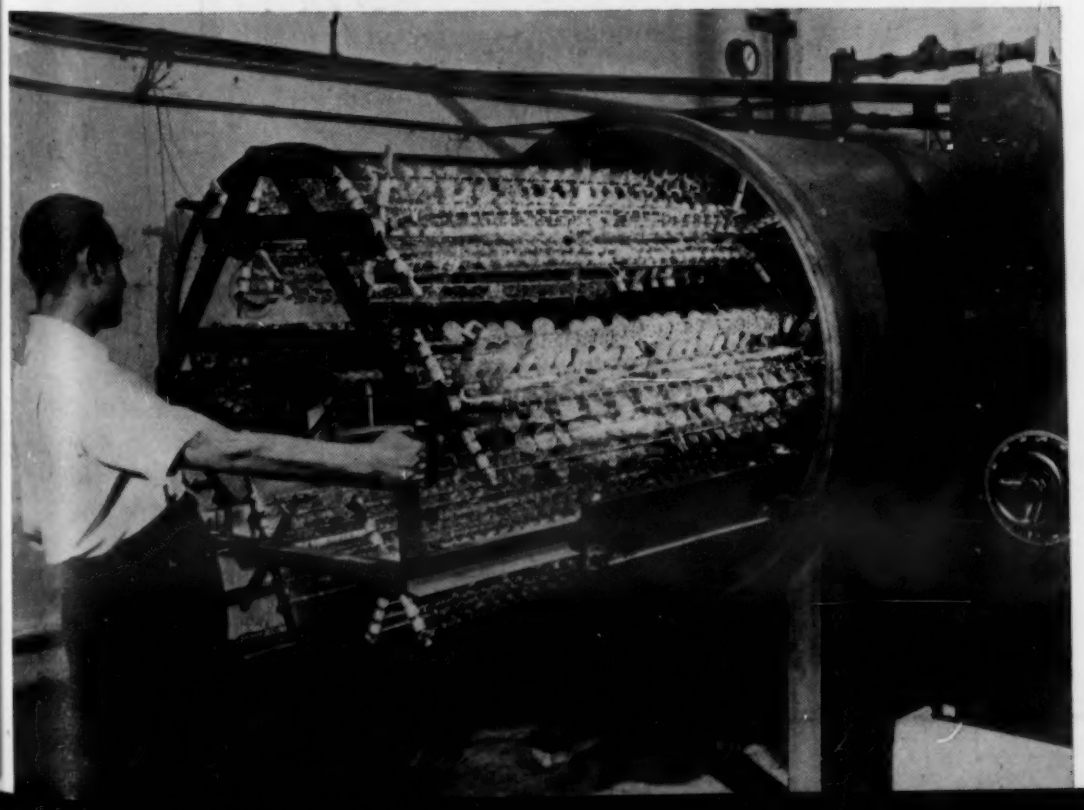
Metallized plastics have replaced nickel-plated steel reflectors in many flashlights.

Economical Coatings by Vacuum Metallizing

High volume production at low cost is leading to increased application of vacuum metallizing on plastics and metals.

by MARK SHEPARD

A system of jigs and fixtures is required to hold the work in proper position while an arrangement is usually included for rotating the parts to assure uniform coating.



● VACUUM METALLIZING, although not a recent discovery, has become an important mass production method, particularly for plastics. The process is used extensively in the electrical and electronic industries, where the combination of metal conductivity and the insulating properties of the plastics offers many advantages. It is commonly used in decorative applications in which appearance is the principal requirement, as in the finishing of novelty jewelry. In such applications, where the production volume is high, it is cheaper to finish by the vacuum process than by other methods. Vacuum metallizing is also used to obtain a highly reflective surface.

A manufacturer of reflectors has recently converted his finishing department to the vacuum method of finishing. The reflective power of his reflectors of polished aluminum by the old method was 62%; by the vapor process it was increased to 85%. Some manufacturers of flashlights have replaced the conventional polished nickel-plated steel reflectors with a plastic reflector metallized in high vacuum. The results are a more reflective surface and a substantial saving of man hours and costs.

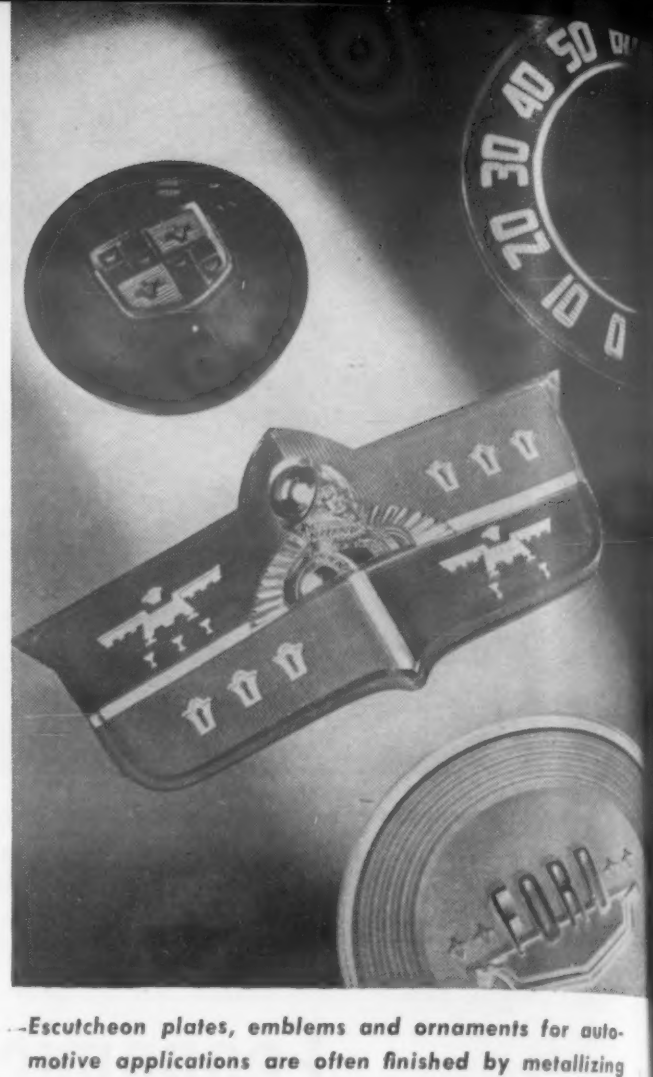
Metals and Nonmetals Coated

The basic principle of the vacuum method is the fact that metal vaporized in a vacuum travels in a straight line until it comes in contact with an object. Upon contact, condensation occurs and the object is coated. Various materials can be coated, the most common being glass, most plastics and some metals. On plastics, the common coating agent in use today is aluminum. On polystyrene, molded and cast Plexiglas and Lucite, silver, gold and copper are also applied.

Vacuum coating equipment can be quite compact and readily fitted into an assembly line. The major requirements are a chamber, which can be evacuated to low pressure by a system of pumps and held at this pressure for a short time, and a firing system to generate sufficient heat to vaporize the metal. For aluminum, this temperature is 1832 F at 10^{-2} mm of mercury. For satisfactory metallizing, a pressure of 1 to 2 microns of mercury is the highest that can be tolerated, while the optimum operating pressure is 0.5 micron.

A system of jigs and fixtures is required to hold the work in the proper position, while an arrangement is

In novelty jewelry applications, where the production volume is high, vacuum metallizing is usually cheapest.



Escutcheon plates, emblems and ornaments for automotive applications are often finished by metallizing the under surfaces of transparent plastics.

usually included to rotate the work to obtain uniform coatings.

To obtain a clean, smooth finish upon the items to be metallized, a sub-coating of lacquer is used. The texture of the finished metal coating depends on the selection of the proper type of lacquer.

The most common method of applying sub-coats is to fasten the items on racks and dip them into the tank of sub-coating material. An article that contains a great deal of detailing and fine embossing should have a thinned lacquer undercoat, while an article that presents a smooth flat surface can have a heavier undercoating. This lacquer is allowed to drain off evenly to present a smooth clean surface. When draining is completed, the racks are often placed in an oven at about 140 F and left there until thoroughly dried. Particular care is taken not to mar or smudge the items at this stage because a finger mark, dust or lint will deface the finished product. This undercoat also serves the purpose of filling in minute cracks in the items to be processed and acts as an adhesive agent during the firing period.

For aluminum coating, commercial aluminum wire 0.070 in. in dia can be used in lengths of about ½ in. This wire is looped over a tungsten filament and spaced to obtain optimum coverage, a necessity because the aluminum particles upon vaporization travel in straight lines with the tungsten filament as the axis. Then the rack of coated parts is placed in the chamber and evacuation is started. It requires 25 to 30 min in an average size chamber to reduce the pressure to 0.5 microns. At this point, the tungsten wire is heated to the temperature required to vaporize the aluminum, and the vapor deposition is completed in about 2 to 3 min. The thickness of the metallic deposit is usually about 0.00001 to 0.001 in.

Because the metallic coating is so thin, it has little abrasion resistance, and for many applications a protective coating of clean lacquer must be applied to the product after it is removed from the vacuum chamber. This coating, referred to as top coating, is also a special type of lacquer manufactured for this particular purpose. It does not have the adhesive qualities that the undercoat possesses, for as a finish this would be undesirable. The same method of dipping and draining is used as in the undercoating process. Sometimes, upon removing the item from the top coating tank a dull film forms on the surface, called a blush. This usually occurs when an excess of moisture is present in the atmosphere. To overcome this surface blush, the coated articles must be placed immediately into the drying oven for a few moments.

Colored Coatings Possible

For ornamental objects requiring a color other than silver, the parts are dipped into a dye solution after completing the top coating process. Unlike the lacquering process, where drainage and drying is required, the dyeing process is completed by washing off the excess dye in clean cold running water and then drying with an air hose. One Eastern plant has been able to metallize and dye items in as many as three colors. Utilizing the metalized finish as a base, a system of blocking jigs was devised and the dyes were applied by spray instead of the usual dipping. The effect is most colorful and eye appealing.

In a modified procedure, the metal is deposited on the rear surface of transparent plastics. This method has the advantage of offering a bright metal surface that requires no lacquer overcoat since it is protected from damage by the plastics material. The coating is frequently backed with lacquer or paint for additional protection.

The average high vacuum system costs from $20,000 to $40,000, depending upon the size of chamber and the amount of auxiliary equipment needed. The equipment requires care, but there should be very little cause for stoppage due to breakdown if proper precautions and cleaning procedures are followed. Breakdowns occur in the diffusional system or result from the faulty cleaning of the vacuum chamber, racks and jigs.

In order to have the work come out of the chamber in a clear, clean, metallized state, the aluminum deposited in the chamber must be removed and the racks and jigs used in the chamber must be cleaned weekly. Failure to remove the deposit causes an excess of gasses and pressure upon firing and the metallized finish will appear scorched.

A cost comparison of the three coating methods most commonly used today is given in an accompanying table. The figures were derived by a production analysis of an item that was produced in volume by all three methods listed and show clearly the advantage of the use of vacuum coating in this application.

Comparison of Production Metallizing Processes

	Silver Reduction	Electroplating	High Vacuum
Quantity Produced	15,000 units	15,000 units	15,000 units
Appearance	Bright, clean. Dulls with age.	Bright, slightly rough. May dull with age.	Bright, clean. Remains bright.
Wearability*	Good	Excellent	Good
Time Required	9 man days	8 man days	3 man days
Cost per Unit	$.07	$.13	$.03

** Topcoating used on silver reduction and vacuum methods.*

Applications

The applications of vacuum metallizing are determined by the properties of the coating. Since the film is only about 0.00001 to 0.001 in. thick, it has little abrasion resistance and must be protected in some manner. Further, the coating is too thin to mask defects in the base material or to be subsequently polished or repaired. Thus, vacuum coating cannot replace electrodeposition in all applications, although it is applicable to many.

Vacuum metallizing is used in both engineering and decorative service. Most of the former lie in the electrical or electronic fields. Components such as capacitors and resistors are made by coating paper with aluminum or zinc and mica with silver. Other applications include the coating of television receiving tubes, the preparation of infra-red lamp reflectors, and the production of printed circuits. An important application is in the production of mirrors for reflecting telescopes and similar applications.

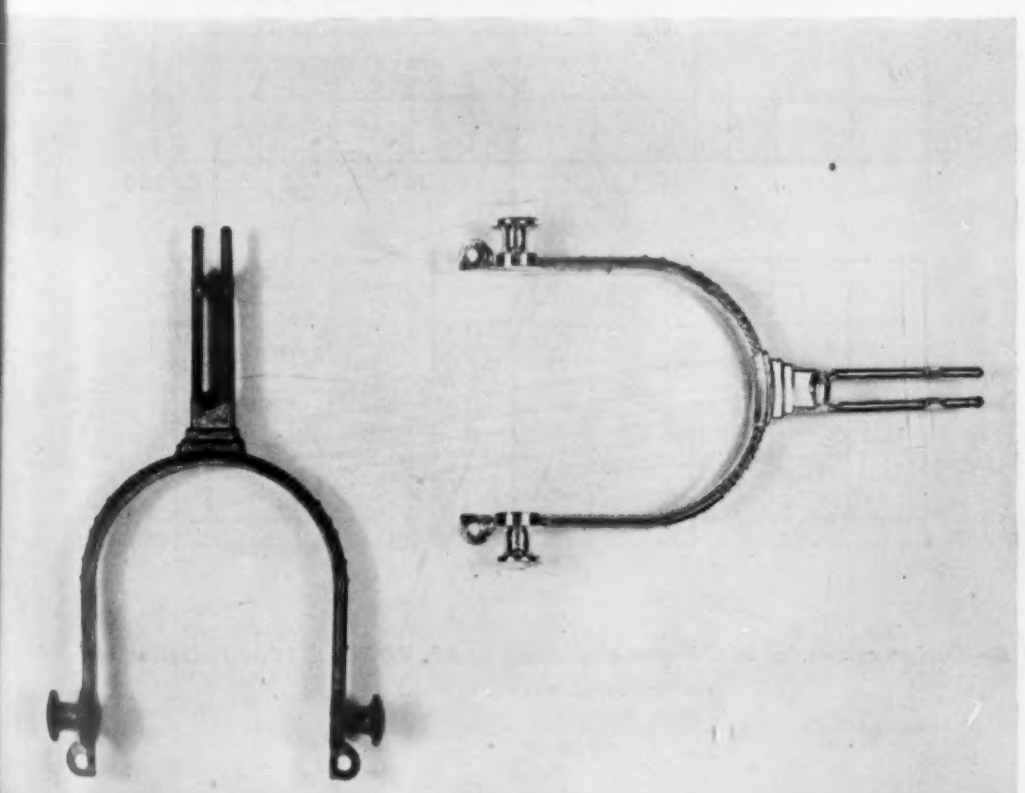
In the field of decoration, coatings, particularly on plastics, toys, inexpensive jewelry, Christmas ornaments, buttons and various novelties, are produced by vacuum metallizing. The process is used for the coating of various fabrics for special effects and in the production of decorative wrapping papers.

In the automotive field, transparent plastics metallized on the under surface are used extensively. Every standard make automobile has some parts produced by this method. These include horn buttons, instrument panel escutcheon plates, emblems, push-button door openers, and radiator ornaments.

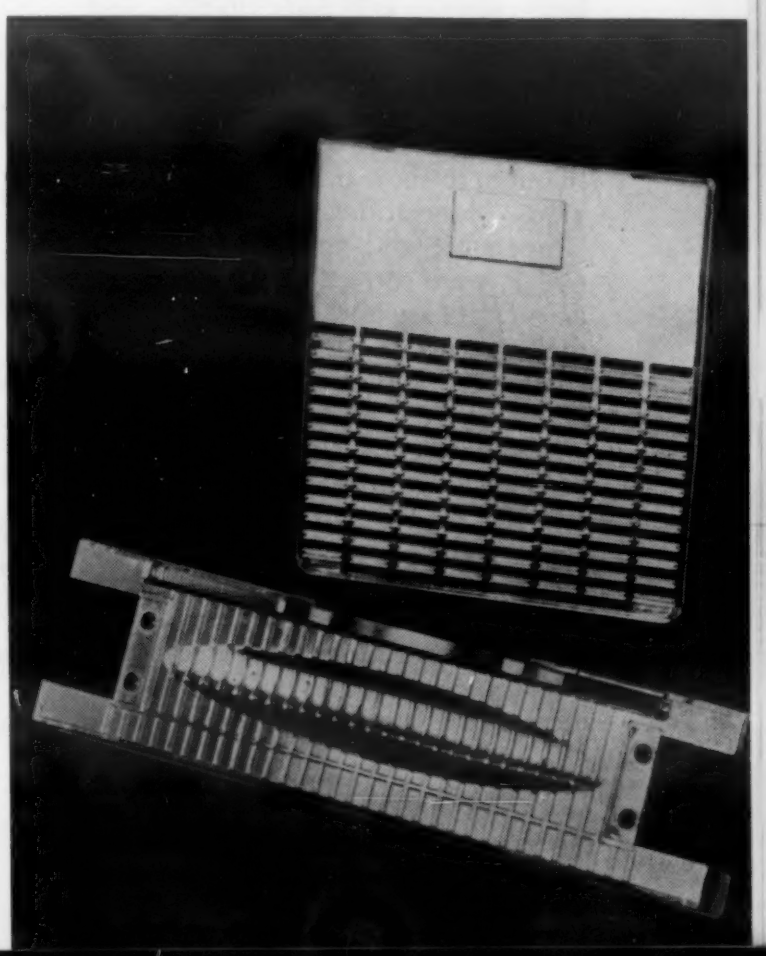
The process is used also for the finishing of metals, particularly die castings. Medals, trophies and religious articles are frequently gold or silver plated in this manner.

Films a few millionths of an inch thick are deposited by vacuum metallizing on glass for special applications. Such films are transparent and have been used to obtain heat reflecting and electrically condutcing surfaces on the glass.

The appearance of metal parts such as these spurs is greatly improved by vacuum metallizing. The metallized spur is shown on the right.



Grill and top of radio cabinets are metallized for improved appearance.



Creep Properties of Titanium

by D. R. LUSTER, W. W. WENTZ and D. W. KAUFMANN, Rem-Cru Titanium, Inc.

Creep at room temperature and absence of creep in the range of from 400 to 600 F make titanium unique among structural metals.

● SEVERAL YEARS AGO room temperature creep test results were reported by Dr. H. Adenstedt of Wright Air Development Center which indicated that commercially pure titanium had surprisingly low resistance to creep at room temperature. Rem-Cru, in cooperation with Battelle Memorial Institute, had previously investigated the creep characteristics of titanium in the temperature region 400 to 1000 F and had found no evidence of creep at temperatures below about 650 F. These results have been confirmed by F. B. Cuff, Jr. and N. S. Grant (*Iron Age,* Nov. 20, 1952) at 700 F and above.

Because of the seemingly contradictory results, Rem-Cru started work in 1950, in cooperation with the Battelle Memorial Institute, to investigate more fully the creep characteristics of both commercially pure titanium and the titanium alloys. Although the tests are far from complete at the present time, sufficient data have been accumulated on commercially pure titanium to show that both of the previous observations, creep at room temperature and no creep at 400 to 600 F, were correct. In addition, sufficient data are now available to allow the construction of design curves for commercially pure titanium at temperatures from 80 to 1000 F.

These data cover the two grades of commercially pure titanium, RC-70 and RC-55. RC-70 is the more common grade and is approximately 99.0%+ titanium with 0.2% max carbon, the balance a variety of the common contaminants iron, oxygen, nitrogen, and traces of other elements. The strength temperature rela-

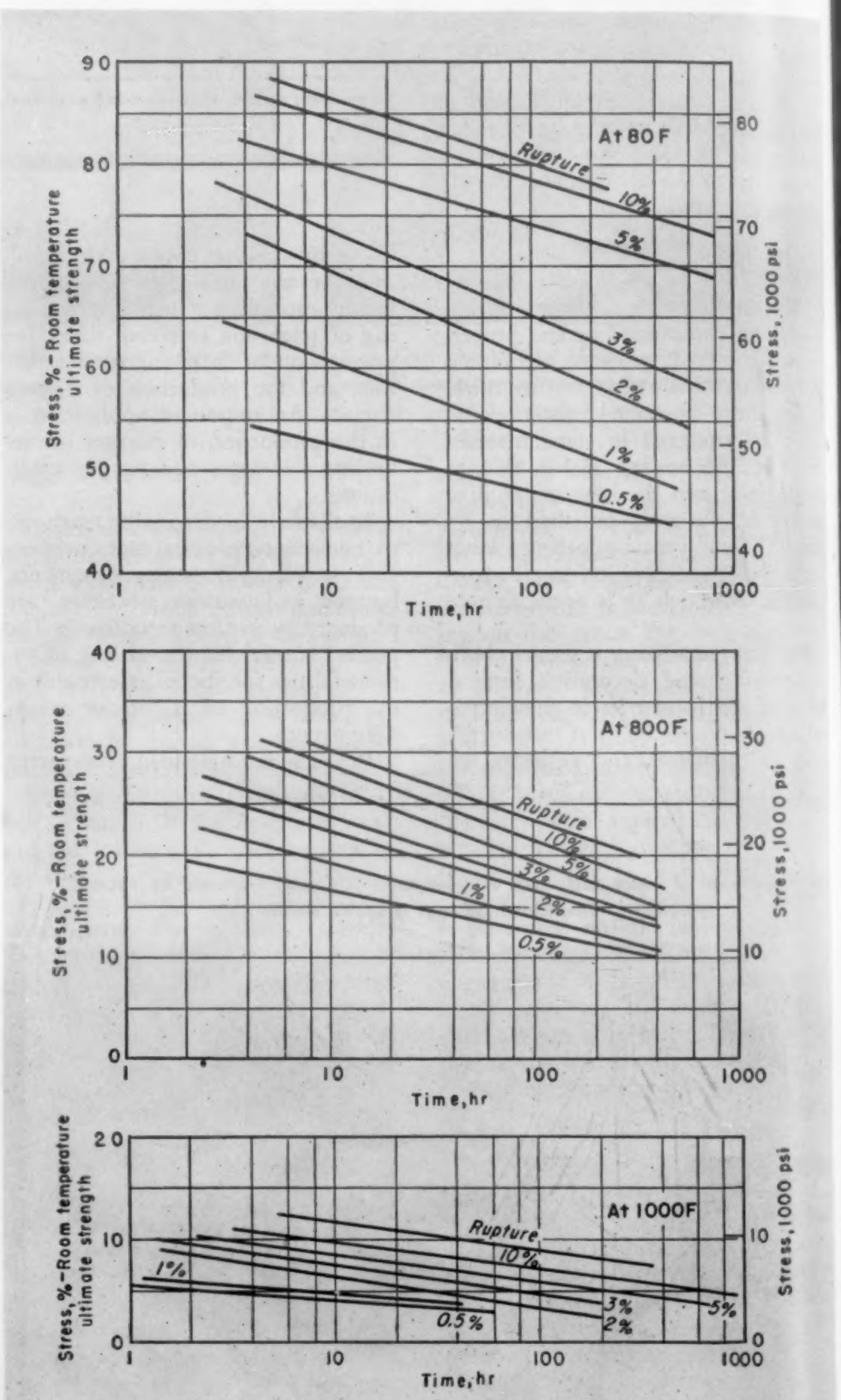


Chart A—Design curves for RC-70 annealed sheet at 80, 800 and 1000 F. (Stress vs. time for indicated deformations.)

tion for RC-70 is shown in Fig. 1. The strengths and ductilities shown represent nominal values for annealed sheet material. Naturally, all heats do not show strength and ductility values that fall exactly on these curves. However, most RC-70 material falls within ±10,000 psi of the strength values shown. RC-55 titanium is a somewhat higher purity grade of unalloyed titanium having a composition of approximately 99.2%+ titanium and 0.2% max carbon, plus a small amount of the other common contaminents. This higher purity material has somewhat lower strength and higher ductility than RC-70. The strength and ductility of RC-55 are shown in Fig. 2. Again, these values are average values with the normal scatter lying within ±10,000 psi.

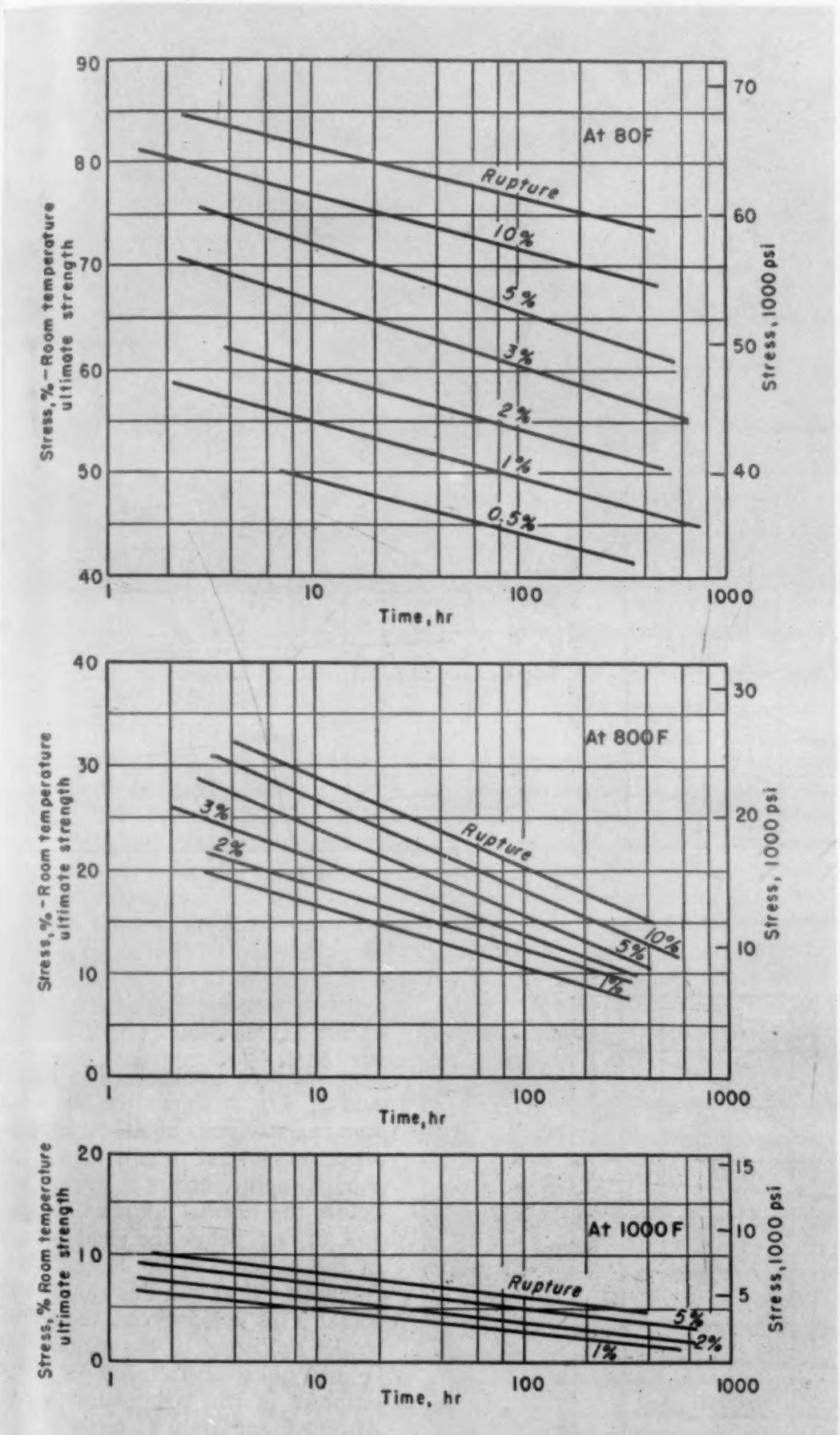


Chart B—Design curves for RC-55 annealed sheet at 80, 800 and 1000 F. (Stress vs. time for indicated deformations.)

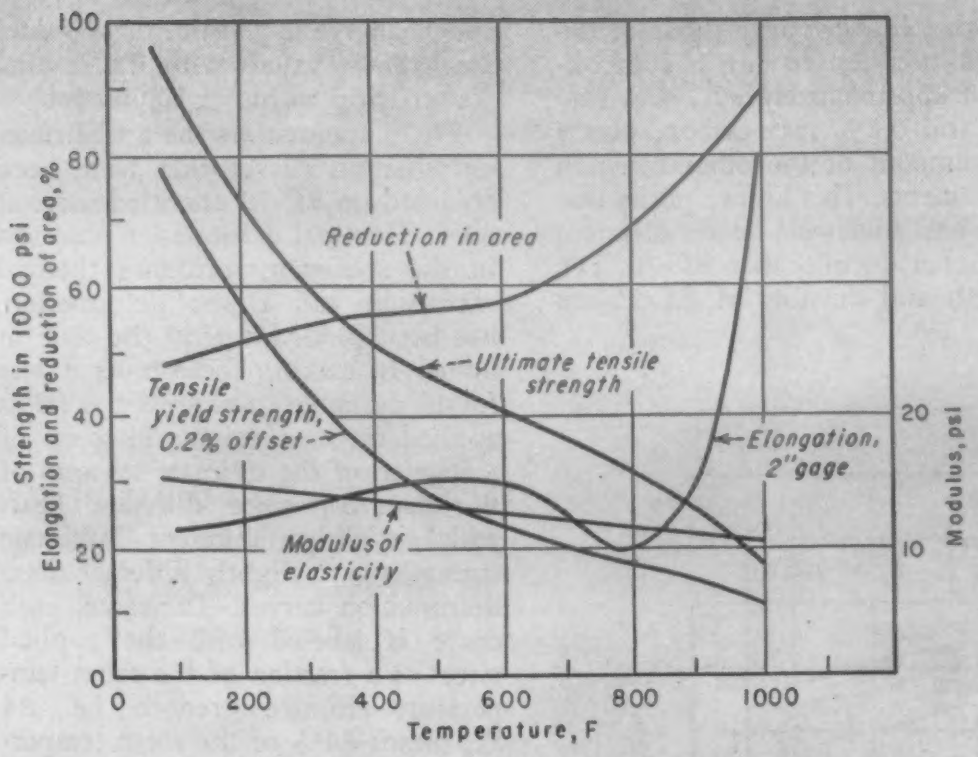
Fig. 3 summarizes the actual time-deformation curves that have been obtained on RC-70 annealed sheet at 80 F. The total deformation observed in the specimen, including thermal expansion and elastic deformation, has been plotted against the time in hours. In making these plots it was found desirable to express the stress applied to the specimen in terms of a fraction of the ultimate strength of the material, since different heats with slightly different ultimate strengths gave slightly different time-deformation curves. Therefore, each curve is labeled with the applied stress as a fraction of the room temperature ultimate strength, *i.e.* .84 F_{tu} means 84% of the room temperature ultimate strength or approximately 80,000 psi. In those cases where rupture occurred, the rupture time is given in hours and the rupture elongation is given in percent.

Inspection of the curves obtained at 80 F shows that at stresses near the yield strength (approximately 84% of the room temperature ultimate strength) fairly rapid creep occurs, followed by rupture in approximately 26 hr. Stresses must be reduced to approximately 45% of the room temperature ultimate strength (about 43,000 psi) before creep becomes negligible.

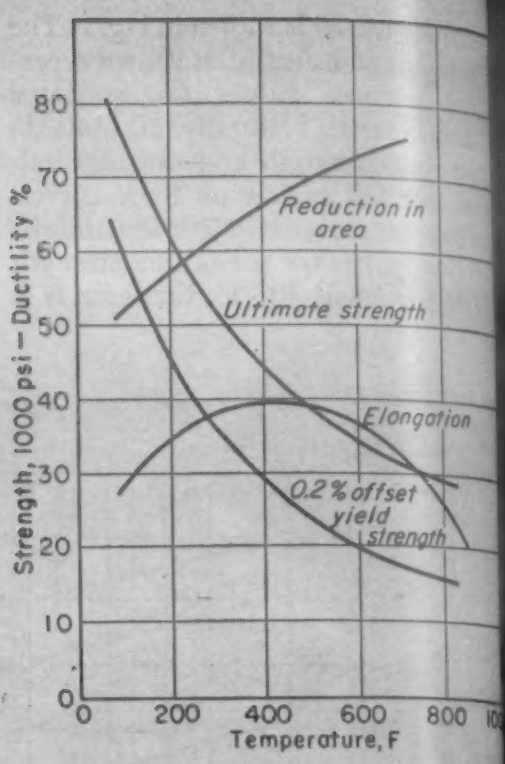
At 400 F, however, stresses of 45% of the room temperature ultimate strength, which are well above the yield strength (approximately 35% of the room temperature ultimate strength) at that temperature, show no creep although some permanent deformation does occur, since the stresses are above the yield strength. It is only when the stresses approach 47% of the room temperature ultimate strength, which is practically the ultimate strength of the material at 400 F, that creep and rupture take place in a fairly short time.

The data obtained at 600 F show similar characteristics. The yield strength at 600 F is approximately 25% of the room temperature ultimate strength. Specimens stressed above this value show some initial deformation since they have been stressed above the yield strength but show no creep.

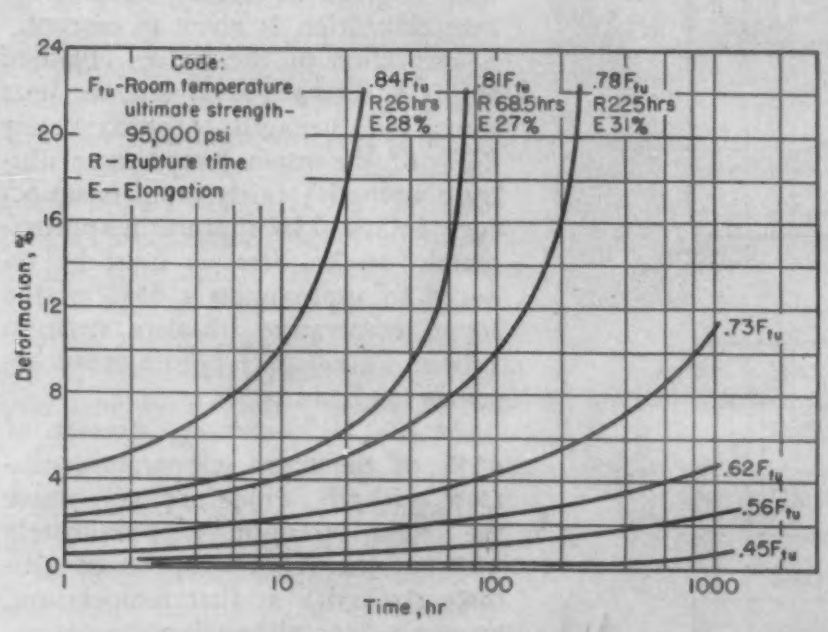
At 800 F and 1000 F creep again becomes an important consideration. Stresses near the yield (19% of the room temperature ultimate strength) cause appreciable creep and even rupture. This time-deformation informa-



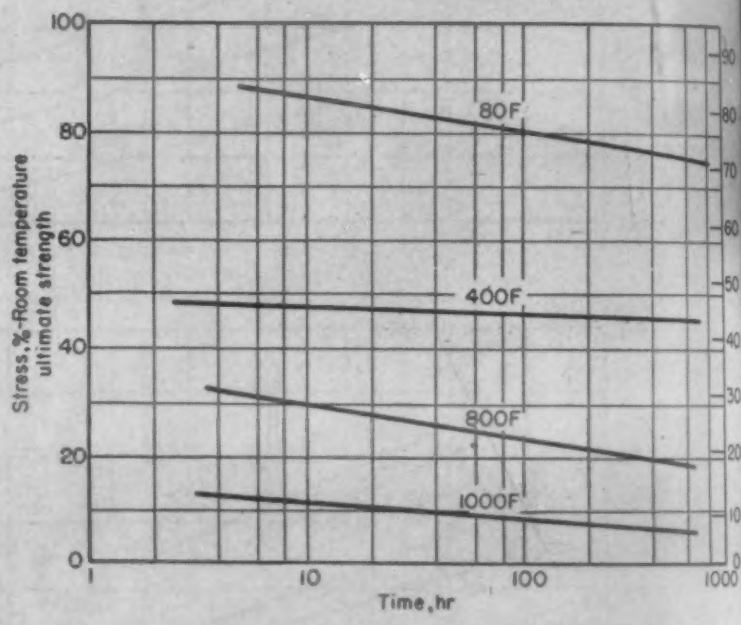
Effect of temperature on the short time tensile properties of RC-70 annealed sheet.



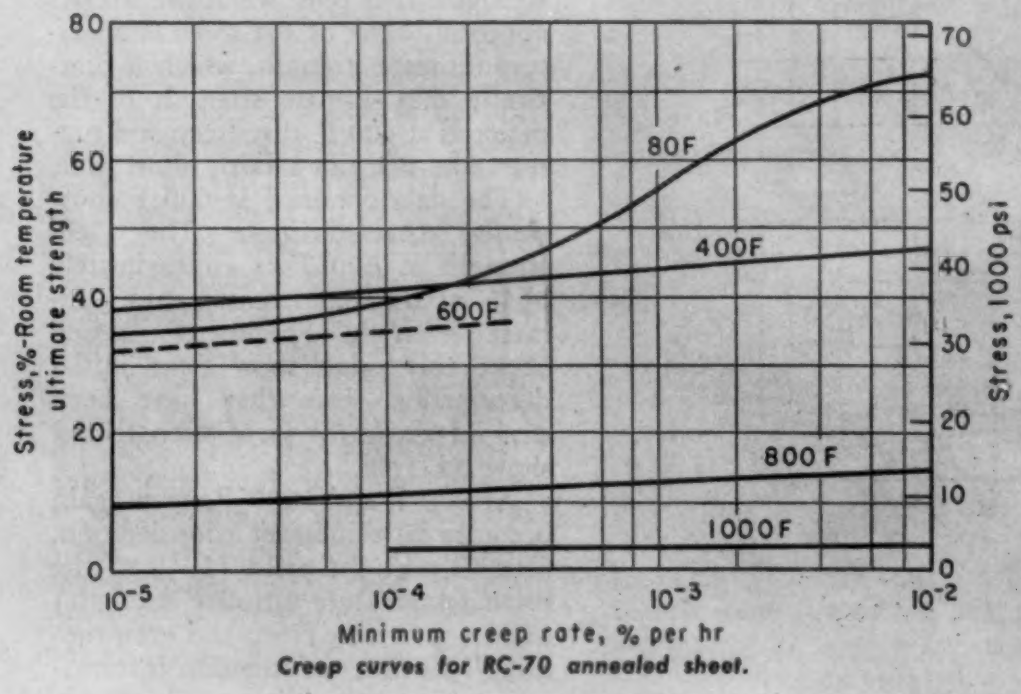
Effect of temperature on the short time tensile properties of RC-55 annealed sheet.



Time-deformation curves for RC-70 annealed sheet at 80 F.



Stress-rupture curves for RC-70 annealed sheet.



Creep curves for RC-70 annealed sheet.

tion has been summarized in Figs. 4 and 5. Fig. 4 shows the stress-rupture characteristics of RC-70 annealed sheet at several temperatures. Although rupture occurs at stresses well below the normal ultimate strength and, in fact, below the yield strength of the material at 80 F, the stress-rupture curve at 400 F is almost horizontal. This indicates that the normal tensile properties of the material can be used quite satisfactorily for design purposes in this temperature range. At 800 F and 1000 F, creep rupture again become important and must be taken into account for applications requiring long-term resistance to def-

Aircraft tail-cone assembly produced from unalloyed titanium.

ormation.

Fig. 5 shows the minimum creep rate observed in percent hour at a variety of stresses and temperatures, and illustrates the gross difference in creep characteristics between room temperature (80 F) and the intermediate temperature range 400 to 600 F. At room temperature the stress must be dropped an appreciable amount in order to reduce the creep rate to a negligible quantity, whereas at 400 F and 600 F creep does not become an important consideration until the stresses are above the nominal yield strength of the material at these temperatures. In fact, at the lower creep rates the material can withstand a higher stress at 400 F than it can at room temperature.

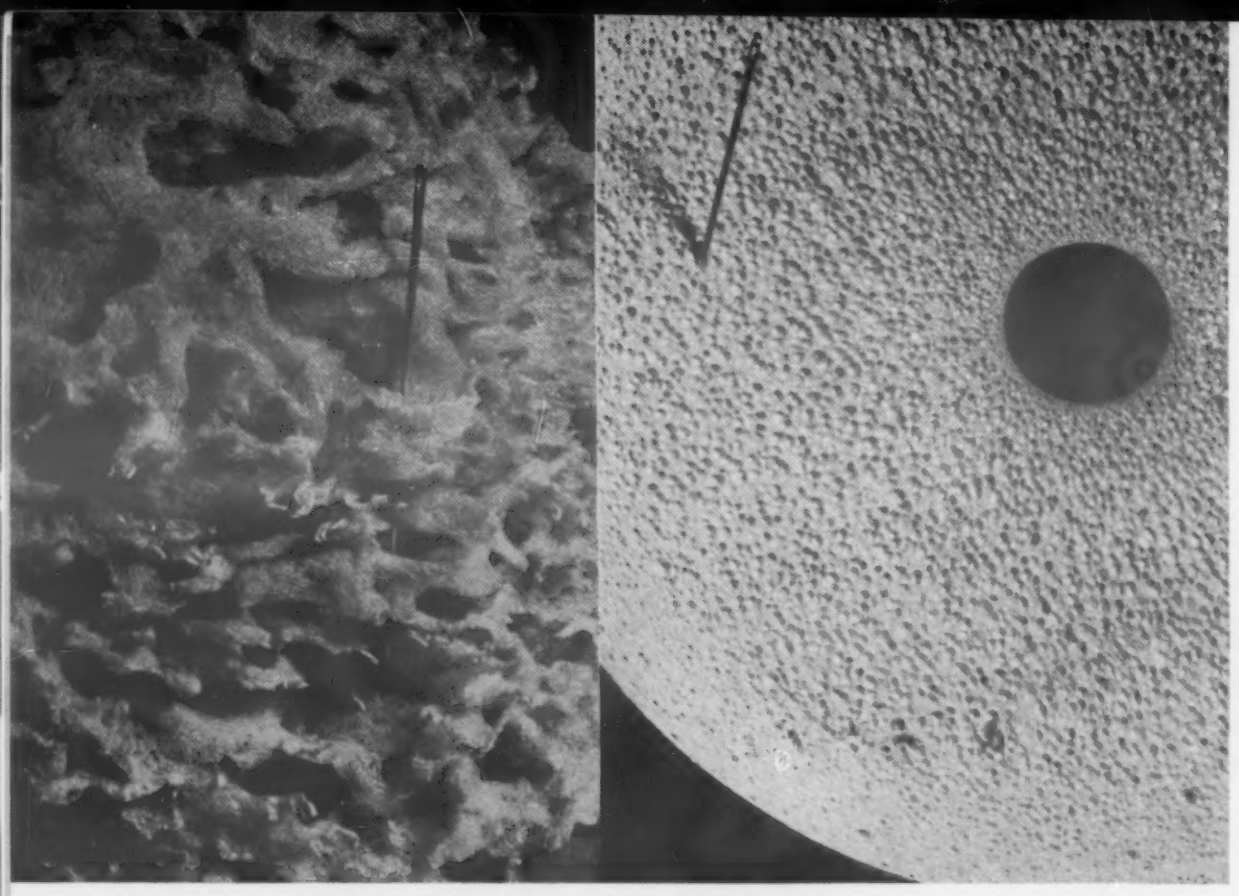
Chart A shows the time-deformation data plotted in the form of design curves at room temperature, 800 F and 1000 F. Since no creep occurs in the intermediate temperature range, 400 to 600 F, these curves become horizontal and the controlling property is the yield strength of the material.

Tests on RC-55 annealed sheet show similar characteristics. At room temperature, stresses must be reduced to less than 40,000 psi before creep becomes a negligible consideration. Again in the intermediate temperature range, 400 to 600 F, no creep occurs. When specimens are stressed above the yield strength of the material at these temperatures, some initial deformation occurs, but thereafter no additional deformation takes place. At 800 F and 1000 F creep again becomes important and stresses must be dropped to quite low levels for long term applications.

Chart B shows the RC-55 creep data plotted in the form of design curves for the temperatures 80 F, 800 F and 1000 F. As in the case of RC-70, in the intermediate temperature range the controlling property, even for long-term applications, is the yield strength of the material.

The reasons for this difference in creep behavior between room temperature and the intermediate temperature range in titanium are not as yet completely understood. One would normally expect that, if a metal showed poor creep resistance at one temperature, it would show increasingly poor resistance at higher temperatures. This is not true for titanium and illustrates the importance of considering titanium a unique material, not closely allied to the more common structural metals.

Two possible explanations for this unique creep behavior in titanium have been proposed. The first suggests that the creep resistance in the intermediate temperature range is due to strain aging effects which strengthen the material and increase its creep resistance. The second suggests that the metal flow takes place in a different manner at lower temperatures, thus causing low creep resistance relative to normal tensile strength determinations. There is considerable activity in this field of investigation at the present time, and it seems likely that the creep resistance of titanium may be improved in the future. Meanwhile, however, the data presented in the previous paragraphs show that commercially pure titanium has quite useful creep characteristics in the important service temperature range up to 750 F.



Water is absorbed rapidly by natural sea sponge (left) because of interconnecting cells, as compared to vinyl sponge (right) which has a closed cell structure.

Vinyl Plastics Sponges

—Their Properties and Uses

by **KENNETH ROSE**, Mid-Western Editor, Materials & Methods

Two structural types—open cell and close cell—are commercially available. . . . They are used where buoyancy, shock absorption, sound deadening, or thermal insulation are needed.

● MATERIALS REQUIRED TO fabricate the products of modern civilization range from strong, dense metals to light, flexible, porous nonmetallics. While many lightweight, porous nonmetallics are available, industry sometimes requires that these materials have an open cellular structure. For centuries a natural material, the sponge, so completely dominated the field that its name has become a word descriptive of all materials having this special type of structure.

While sponges obtained from the sea are still articles of commerce, industry today depends upon man-made spongy materials for many uses for which nature's product would be unsuitable. Sponge rubber, made by trapping air or other gas in coagulated latex, was adopted for sound-deadening, vibration-deadening, shock-cushioning purposes, of which one of the more important was upholstery in automobiles, buses and railway cars (See MATERIALS & METHODS, Apr. 1952, p. 91). Cellulose sponges found use as absorptive materials. Recently those polymerized vinyls which, when properly plasticized, are important competitors of rubber in many fields, now have been formed into sponge also.

Vinyl sponges were a German wartime development. When the German patents were thrown open to American industry after the close of the war, Sponge Rubber Products Co., Shelton, Conn., took up the process, perfected and improved upon it. Using a plastisol of polyvinyl chloride made by B. F. Goodrich Chemical Co., and a nitrogen-liberating blowing agent, sponges of the closed-cell type were produced in a pressure process. Other companies have also taken up the production of vinyl sponge. Elastomer Chemical Corp., Nutley, N. J., working with research by Bakelite Co., produced open-cell sponge atmospherically in intricate molds and laminated to various fabrics. Synthetic rubber sponges, particularly a new all-butadiene synthetic rubber that is odorless, have come into the field as challengers. Foamed rubbers made by whipping air into mixed lattices of synthetic and natural rubbers and coagulating the froth have recently attracted new attention.

Structural Types

Sponge materials, including the vinyls, are of two types structurally. These are:

1. Open cell sponges. These are intended for applications requiring absorbency, or for resiliency where "breathing" is necessary.
2. Closed cell sponges. Most suitable for applications where resiliency must be combined with waterproofness. They are usually made in closed vessels under pressure, and the gas that accomplishes the blowing remains trapped inside the cells of the sponge.

The closed cell sponge is made by dispersing a gassing agent, usually one producing a relatively inert gas such as nitrogen, in a vinyl plastisol, pouring the mixture into a mold, and heating. Heat fuses the plastisol and liberates the gas, which expands the plastic to fill the mold cavity. If an oversize (or low pressure) mold is used, the material will expand to about 10 times its original volume to fill the mold. With an undersize (or

high pressure) mold, the mixture is confined throughout the fused stage into a volume much smaller than the final volume. It is chilled before removal from the mold, and is afterward warmed to the softening point, when the trapped gas expands the piece uniformly to final shape. Pressures used are high—in the 5000 or 12,000 psi range—but the trend recently has been toward lower pressures.

Closed cell sponges are firmer than open cell types. A range of hardnesses is possible, depending upon the amount of plasticizer used. The blowing agent is usually one that liberates nitrogen gas, as this gas shows little tendency to diffuse out of the sponge. Carbon dioxide gas, although

Life preserver made from vinyl plastics sponge has excellent buoyancy. Each cell is filled with nitrogen gas.

Expanded polyvinyl chloride sponge has many uses. Upper left, an unrigged life float. Upper right, boat fender. Lower left, x-ray head clamp. Lower right, fish net floats.

inert, diffuses out quite rapidly.

Recently, a method was developed for making open cell vinyl sponge. The process consists of pouring the vinyl formulation, a liquid, into a pressure cylinder, and introducing a gas under about 400 psi pressure, agitating the cylinder to bring about partial absorption of the gas into the liquid, and running the thick creamy mass into an open mold. The mass fills the mold, and will hold its expanded form for as long as 90 min in the uncured stage. The mold and mixture are placed in an oven at 225 to 275 F for curing. During cure a tough, abrasion-resistant skin forms on all outer surfaces of the piece.

The density of the foam can be controlled by adjusting the composition of the plastisol, the gas pressure, and/or the temperature of cure. Densities of from 12 to 18 lb per cu ft can be obtained. Expansion is about 400 to 800%, depending upon the adjusting of variables.

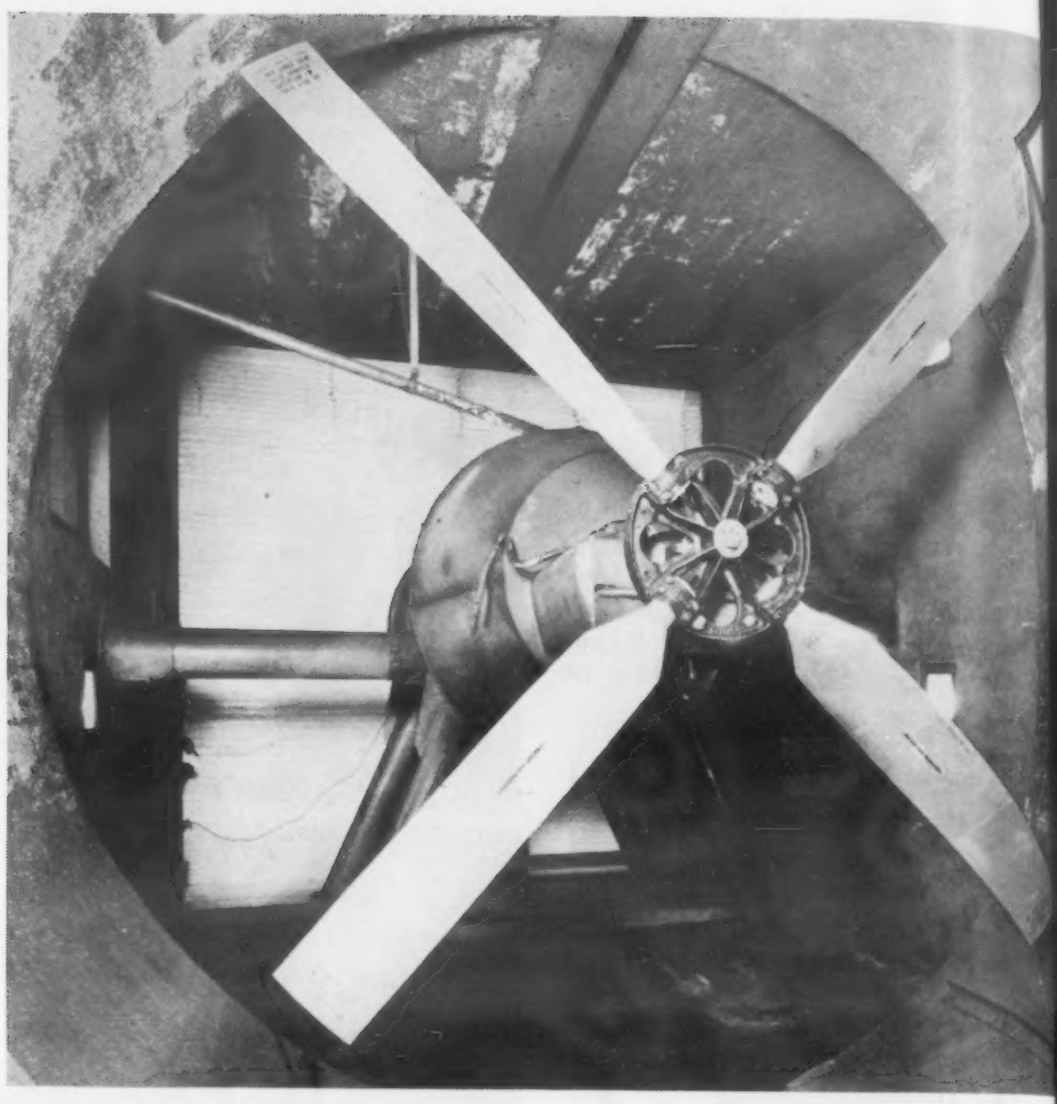
Advantages of the new open cell method are ease of fabrication and low cost of equipment needed. The technique involves no critical handling, and the cylinder and molds can be inexpensive and simple. Intricate shapes can be molded, and the molded piece can be laminated to natural or synthetic fiber textiles. The laminate can be cured in place on the fabric.

In addition to the vinyl chloride polymers, vinyl acetate has been made as an open cell sponge. It is too tacky as made, so it is dried with formaldehyde to produce polyvinyl formal sponges. These have some application as cleaning sponges.

Closed cell sponges are used for their buoyancy in life rafts, floats, fenders, and the like. A highly plasticized sponge is much used in military vehicles for padding and sound deadening. It also provides thermal insulation in such vehicles. Open cell is used in upholstery in vehicles and furniture, for absorbent sponges for cleaning, shock absorbency, and similar purposes.

Both open and closed cell vinyl sponges are flame resistant, resistant to aging, rot, bacterial action, most chemicals, and do not dry out or harden. They possess good strength and resiliency. They are practically odorless, and can be made in any color.

PICTURE CREDITS: B. F. Goodrich Chemical Co.



ASSEMBLED FAN, in which effective materials redesign was accomplished, is given a trial run in the test chamber.

Nodular Iron Plywood Hot Dip Coating Make Better Fans

by SIDNEY H. FEDAN, Manager, Aeromaster Fan Dept., Metal Products Div., Koppers Company, Inc.

A metal, a nonmetallic and a coating are combined to meet the rigid requirements imposed on industrial cooling fans.

● COMPLETE MATERIALS REDESIGN has enabled the Metal Products Div. of Koppers Co., Inc., to produce industrial cooling fans which last longer than before and are more easily and economically fabricated.

Two years ago this company's fan blades were carved out of laminated wood made up of ¾-in. plies; the blades were protected by a plastic sheet laminate; and the fan hubs were machined steel castings. Today, a plywood of ⅛-in. veneers is used for the blades; they are protected by a hot-dip gel lacquer; and the hubs are machined from ductile (nodular) iron castings. In each case, the change has either improved performance or reduced fabricating costs without sacrificing quality.

The propeller-type cooling fans produced by Koppers range in size from 54 in. to 24 ft in dia, and can deliver up to 1,000,000 cfm in continuous open-air operation. Standard models may have four, six or eight blades per fan. Aerodynamic principles are incorporated in the design of Aeromaster fans.

The principal components of a fan are the hub and the Aeroloid

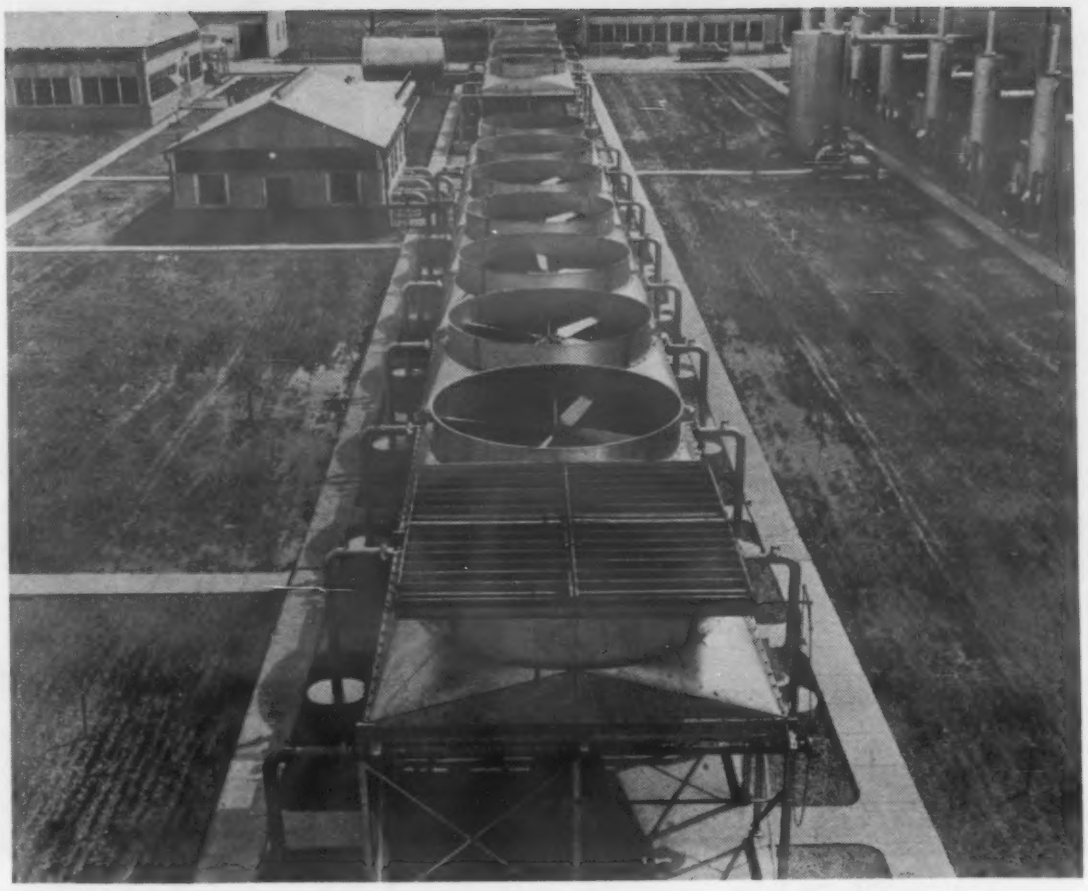
blades. Koppers buys the hub casting, machines it to required tolerances, and covers it with a protective coating. Koppers also buys blocks of plywood of various sizes, which it carves down to carefully shaped blades with shanks. Steel ferrules and back up plates are fastened to the shanks with lag screws. The blades are then coated with primer and lacquer. Each blade is checked individually for width, thickness and blade angle, and is balanced to specification by feeding lead slugs into a hollow shaft running from the shank end part way into the blade. Finally, the Aeroloid blades are clamped into the hub, and the whole assembly is checked for proper balance.

The Hub

Fans used in cooling towers are usually subjected to much more vibration than that caused by the fans themselves. Some of these towers, used to cool engine jacket water, are located near pipe-line compressor stations where vibration of large stationary diesels and heavy compressors shake the ground for some distance around.

Because of this vibration, the metal fan hubs which clamp the propeller blades must have better tensile and fatigue strength than cast iron. The hubs range in weight from 50 to 225 lb and, although they vary somewhat in design, all have a heavy center hub, a heavy flange and thin interconnecting webs. Originally, the desired properties were obtained in steel castings. Every steel hub assembled did its job satisfactorily, but many castings that were rejected after machining revealed blowholes and inclusions. Also, machining time was excessive, tool life was short, and tool breakage was high. Unmachined surfaces were rough and unattractive.

To reduce production costs and delays, Koppers turned to malleable iron for hubs. The Standards Dept., which sets time for all machining operations, reported 20% time savings on some operations, if and when machining was not interrupted. But the other drawbacks found in steel persisted with malleable. Porosity was even worse and inclusions were uncovered which could not be smoothly cut through with carbide tools even after annealing. The rejection rate in malleable ran at 11%, and even then the engineers were dubious about the sound-



***COOLING TOWERS** installed at this gas transmission station are a typical application for the industrial fans manufactured by Aeromaster Fan Dept. of Koppers Co., Inc.*

***NODULAR IRON** has replaced steel and malleable iron in the hub casting. Result: faster machining, longer tool life, less tool breakage.*

PLYWOOD OF 1/8-in. veneers has replaced wood of 3/4-in. plies. Result: higher material cost, but longer blade life.

ness of large unmachined sections.

In the belief that commercially sound castings might be obtained in a relatively new material—nodular or ductile iron—Koppers took its hub problem to American Brake Shoe Co., whose Brake Shoe and Castings Div. had been producing ductile iron (under the trade name Ductalloy) for approximately two years. As a result, a ferritic grade of ductile iron was selected, with the following minimum properties:

Tensile strength, psi	60,000
Yield strength, 0.2% offset, psi	45,000
Total elongation, %	10
Mod. of elasticity, psi	22×10^6
Brinell hardness, Bhn 3000 kg	165/185

A number of foundry problems had to be solved before sound, reproducible castings could be made available. For instance, Koppers' pattern equipment had to be changed to conform to flask sizes and to make enough room for the gating system. Changes in gating, shakeout time and heat treating were made to eliminate a tendency toward cracking in thin sections. And it was found that the metal had to be poured at a higher-than-normal temperature and at the fastest rate possible without washing sand out of the mold.

After the ductile iron castings have cooled they are shot-blasted. Gates and risers are removed, and the hubs are specially blocked to prevent warping during heat treatment. Following heat treatment, the hubs get a second cleaning and are shipped to Koppers.

After being machined to set tolerances, the hub surface, with the exception of bearing surfaces, is primed with Parco-Lubrite and coated with Koppers' own Bitumastic, a permanently soft bituminous mastic. So far, no hub has been rejected.

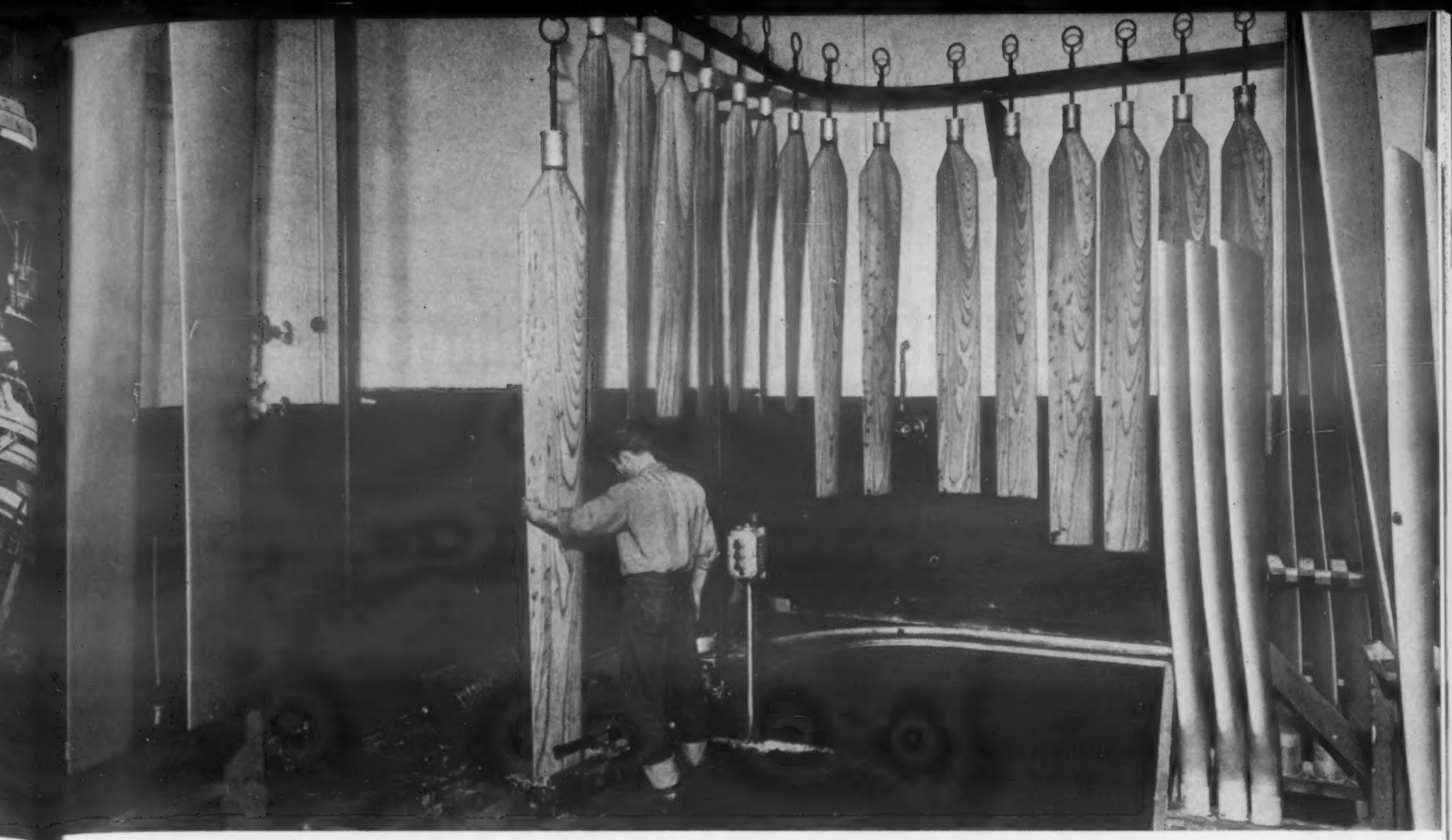
The Koppers Standards Dept. has not set new time on all machining operations, but several comparisons can be made between ductile iron and the malleable iron formerly used. Lathe speeds and feeds are up 10%, tools last about 25% longer without sharpening, and tool breakage has dropped by one-third.

The Blade Material

Koppers, the only industrial fan producer using plywood for blades, began to use the laminated material back in 1940. Wood has two main advantages over metal: it is lighter, and it will not fatigue. Lighter weight means less centrifugal force on the fan assembly, adding to the life of the fan and of the supporting bearings and structure. Many metal blades have failed by fatigue as a result of harmonic vibrations, but wood can take repeated stresses without ill effect.

Older types of plywood, laminated with animal glue, would not have been suitable for high-powered fans. But the advent of plywoods bound with tough phenolic resins made possible the use of this material under much more severe stress conditions. At first Koppers used wood, either maple or birch, composed of 3/4-in. plies. About two years ago, however, a change to 1/8-in. veneers was made. Since the new material cost twice as much as the old, such a change was not made lightly. Although no advantages in fabrication were obtained, a number of important technical advantages were gained.

The new material differs from the old in three ways, all related: (1) many more plies or layers per given section, (2) more resin per given section, and (3) a greater proportion of the wood impregnated with resin. The greater number of plies, with the wood grain oriented in different directions, gives the blade better torsional rigidity. The greater number of resin barriers and larger proportion of resin-impregnated wood tend to inhibit much more the



HOT-DIP GEL LACQUER has replaced plastic sheet formerly laminated on to blade. Result: lower material cost and much lower labor cost.

loss or gain of moisture. This stabilizes moisture content and prevents blade warpage.

These factors of greater rigidity and stability are estimated to double the life of Aeroloid blades.

The Blade Coating

Cooling tower fan operation necessarily implies the presence of moisture, corrosive chemicals and often abrasive particles. To protect fan blades against these conditions, Koppers uses a thick, tough plastic coating.

Until recently, a cellulose nitrate primer and plastic sheet were used. Before being applied, the sheet of cellulose nitrate had to be softened by immersion in a solvent. It was then cemented on one side of the blade by hand and smoothed out by a pressure roller. Efforts to speed up this operation by means of an autoclave or pneumatic boot were unsuccessful, as small airpockets and wrinkles could not be eliminated. After excess sheet was trimmed, the blade was set aside to cure for 24 hr. This whole process had to be repeated to cover the other side of the blade. Then the lap joints of the plastic sheets had to be cut down and the whole blade lightly sanded. Finally, the blade was sprayed with a fast-drying lacquer to produce a glossy surface.

As can be easily imagined, the labor cost of this method was high. The idea of a thick coating which could be applied in a single dip operation was attractive. The main design limitation of hot dip gel lacquers is the complexity of the shape, and the fairly simple contour of the fan blade promised little difficulty. The problem was to find a coating system that would have good adherence to the wood. Primers which had good adherence to the wood tended to have poor adherence to the gel lacquer, and vice versa.

The system finally developed with Tennessee Eastman Co. makes use of a cellulose acetate butyrate coating and a mutually adherent primer based on a blend of acrylic and nitrocellulose resins. As used, the gel lacquer contains suitable modifiers in a heated aromatic hydrocarbon-isobutanol solution. It is liquid at 120 F, solid at 100 F. An aluminum paste pigment imparts an aluminum color to the coating, and the gel also contains standard additives which make it noninflammable. The primer contains Paracril CV and nitrocellulose, pigmented with Celite 281 to give it the "tooth" it needs to adhere to the plastic coating.

The blades are dipped vertically in the primer, which is at room temperature, and are then allowed to drain and dry for about two hours. Next they are lowered, again vertically, at a slow and automatically controlled rate into the gel lacquer, which is held at a temperature of 114 F. The blades are withdrawn equally slowly, allowing the excess plastic to run off. Jets of air hit the blade as it comes out, accelerating the setting to prevent downward flow of plastic and resulting "build up" at the tip end of the blade. Excess plastic at the blade tip is clipped off, and any necessary smoothing there is done later with the aid of solvent.

The coating dries to tack in about 5 min, can be handled easily in 4 hr or less, and is firm in 12 hr. It sets up to a final thickness of 0.025 to 0.030 in. The coating is smooth and attractive, and no further finishing operations are needed.

Repairs to the coating, which occasionally is damaged, are not much of a problem. The damaged part is cut away, the surrounding material tapered down, and a solvent-softened patch of the plastic pressed in, smoothed and allowed to dry hard.

The new method cuts costs in two ways. First, the coating material costs only half of what the cellulose nitrate sheets cost. Second, and more important, labor costs have been reduced by more than 50%.

New High Purity Aluminum Alloys

- ***Available in wide range of mechanical properties***
- ***Can be worked readily***
- ***Capable of developing brilliant surfaces***

● A NEW SERIES OF alloys based on high purity aluminum has been announced by the Fromson Orban Co. The alloys, which will carry the trade name Lurium, consist of 99.99% aluminum alloyed with high purity magnesium. It is well known that pure aluminum has much better reflectance than alloyed material and the 99.99% aluminum grade is capable of developing exceptionally brilliant surfaces by anodic polishing. The magnesium content of the alloyed material is sufficiently low to lie in the solid solution range, and brilliant surfaces can be obtained also on these alloys by anodic polishing. Designations and compositions of the materials are given in a table.

Properties

This series of alloys offers a range of annealed tensile strengths from 6000 to 29,000 psi, with elongations of 20 to 60%. The hardness of the annealed materials ranges from 13 to 50 Brinell. The materials cannot be hardened by heat treatment but are work hardenable. Tensile strengths in the hard condition range from 20,000 to 50,000 psi.

Fabrication

The alloys can be compared to type 3S aluminum in working characteristics, although they appear to work-harden somewhat more rapidly. Cold reductions up to 50% are possible. Since high purity aluminum and these magnesium alloys have a tendency toward grain growth, intermediate annealing should be held to a minimum. When annealing is required, type L should be annealed within the range 550 to 575 F, while types L5, L10 and L20 should be annealed at 570 to 625 F. Annealing times range from ½ to 2 hr at temperatures depending on the degree of softness required. Excessive annealing temperature or time will result in the development of an undesirably coarse grain structure.

Because of the purity of the base material, Lurium can develop a higher luster than ordinary commercial aluminum and is practically nontarnishing under atmospheric conditions. It can be anodized and dyed to simulate gold, silver, platinum, brass or other metals but requires a special finishing process which will be made available to fabricators either through a central finishing plant or by licensing.

The various grades will be avail-

Composition and Mechanical Properties

Designation	Nominal Composition, %			Condition	Tensile Strength, Psi	Yield Strength (0.2%) Psi	Elongation, % on 10 Dia	Brinell Hardness
	Al	Mg	Others					
L	99.99	—	0.01 max	Soft Half hard Hard	6,000– 8,500 10,000–13,000 15,700–20,000	2,100– 3,500 4,200–10,000 14,500–18,500	40–60 8–15 4–8	13–18 18–25 26–35
L5	*	0.4–0.6	0.02 max	Soft Half hard Hard	10,000–14,200 15,600–21,400 23,000–27,000	2,800– 5,800 14,200–20,000 21,300–25,800	20–40 6–15 2–6	22–28 35–45 40–50
L10	*	0.8–1.2	0.02 max	Soft Half hard Hard	14,200–18,600 20,000–24,200 25,800–35,500	4,200– 7,100 14,300–21,400 23,000–30,000	20–35 8–15 2–6	30–35 40–50 50–60
L20	*	1.5–2.5	0.02 max	Soft Half hard Hard	21,400–28,600 30,000–35,500 35,000–50,000	7,000–14,300 25,700–32,600 34,000–45,500	20–35 6–15 2–5	40–50 55–75 70–80

* *Balance 99.99% aluminum.*

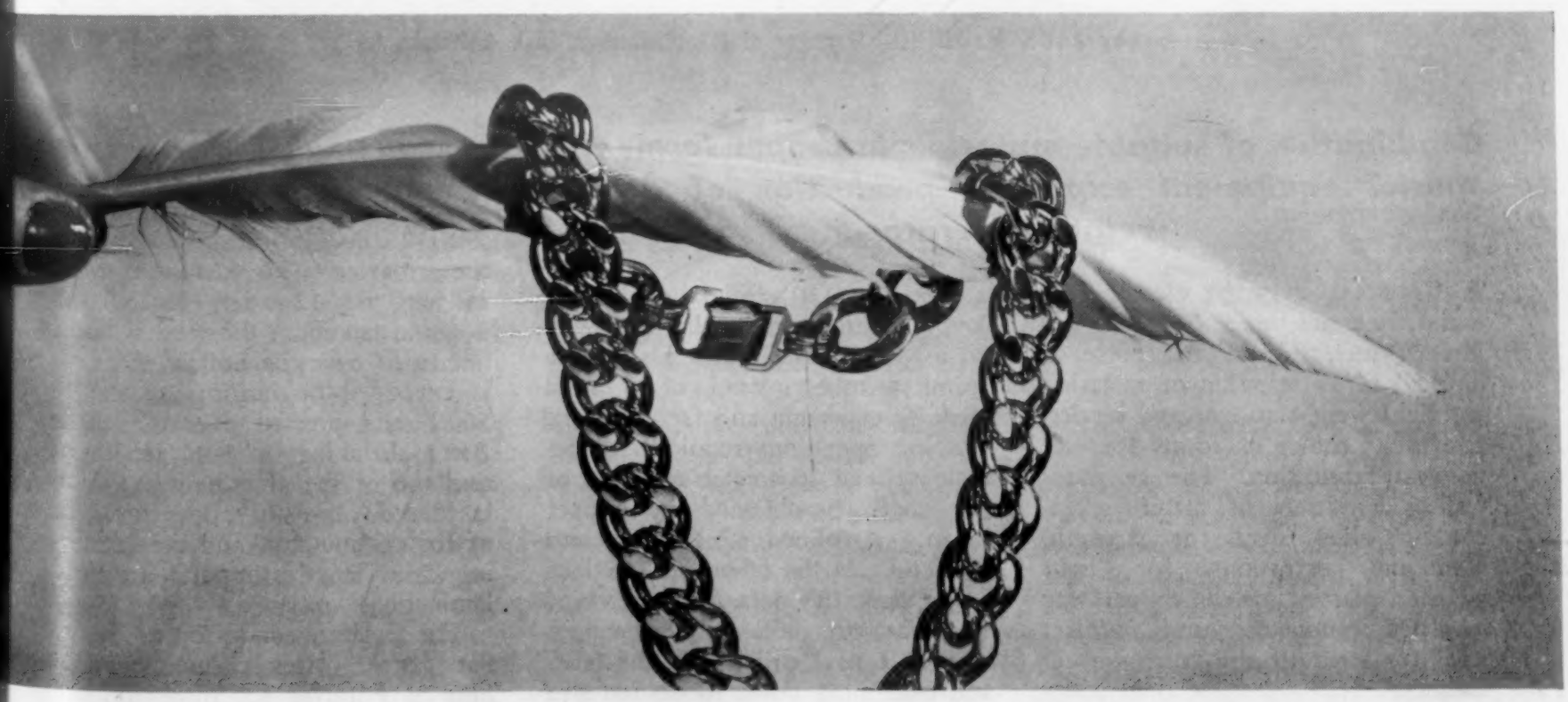
able in commercial quantities in sheet, coiled strip, bars, tubing, wire and circles in soft, half hard and hard temper. Profile extrusions will be supplied as extruded or soft with a minimum section thickness of 0.040 in. in grades L5 and L10 and 0.060 in. in grade L20.

Applications

Typical applications include reflectors, ornamental trim for automotive applications, domestic appliances, and radio and television sets, costume jewelry, lighting fixtures, fancy closures. Because of its high reflectivity, the material has been suggested for thermos bottle liners.

Even when alloyed with magnesium, Lurium has the highest reflectivity of any commercial metal. This property lends to applications in various types of reflectors.

Brilliant light weight costume jewelry was one of the first applications of these materials.



High reflectivity and light weight characterize these new materials.

COPPER CONDUCTOR WIRES *are stacked before insertion into armature slots.*

MICA SHEET INSULATION *is inserted into the cell slots.*

Careful Materials Selection Speeds P

by **JACK McGINNIS**, Manager of Manufacturing, Jack & Heintz, Inc.

Combination of suitable materials in proper forms plus special equipment expedites production of a light weight generator.

● A SPECIAL TYPE OF electric generator, manufactured by Jack and Heintz, Inc., for the Air Force, is unusual in its selection of materials for light weight and rugged service, and in its choice of forms for economical fabrication. The generator utilizes a variety of materials, including alloy steel for strength, aluminum extrusions for light weight, plastic coated copper for insulated conductors, and stainless steel for strength and corrosion resistance.

The generator rotor is built around a tube of 4130 steel, about 12 in. long, 1⅜ in. outside dia, and with ¼-in. wall thickness. Use of a seamless tube instead of a solid shaft saves weight and facilitates the forming operations required. A female splined section at one end of the shaft is obtained by copper brazing a splined steel collar into that end. At the other end, sections larger than the outside diameter of the tube are obtained by copper brazing a steel collar onto the tube, and machining down to desired size and contour.

Another weight-saving and material-saving device is the use of a star-shaped aluminum extrusion of 24ST-2 alloy to form the body of the armature. This extrusion is 8¼ in. long, has 12 radial ribs, is about 3⅛ in. maximum dia, and is bored out to fit over the hollow shaft. It is expanded by heating to 400 to 500 F and pressed over the shaft. After shrinking, a 3-in. length at one end of the aluminum extrusion is turned down to allow press fit of the commutator, and the remaining 5-in. length supports armature laminations.

The armature conductors are heavy flat copper wires covered with a film of Formvar for insulation. A Jack & Heintz designed single pur-

STAINLESS STEEL BANDS *hold the wires in place on the armature. Bearings are mounted to complete the assembly.*

***ARMATURE UNIT** is inspected and tested for short circuits before insertion into the generator frame.*

ds Production of Special Generator

pose machine strips the edge of this heavy wire, cuts it off to a specified length, and forms it into a hairpin. These copper hairpins are then stacked in a bundle, and formed at the closed end of the hairpin in another single purpose machine to the required number of conductor slot spacings. These conductors are inserted in the slots of the armature lamination. The armature is placed in another single purpose machine and the opposite ends of the hairpin are formed, again to the correct number of conductor slot spacings. This machine also positions the conductor bars in relationship to the commutator bars. The conductor bars are then soldered into the commutator segments.

The commutator consists of alternate copper bars and insulating sheets of mica. The copper conductor bars are brazed on a special resistance brazing machine to the commutator bars to complete the circuit.

Stainless steel bands are then placed over both ends of the armature to hold the conductors in place during rotation, the ground surfaces of the shaft are given a protective plastic coating, and the armature is impregnated against moisture with varnish. After impregnation, the steel bands are machined to meet specifications, and milled, where necessary, to maintain a required rotor balance.

The stator is made up with stacked laminations of oriented silicon steel for the field magnets. A radial drilling machine drills, counterbores, and countersinks 42 holes in the housing to speed assembly. A final inspection completes the operations on the generators.

The generators are used by the U. S. Air Force in airborne applications on military aircraft, and on auxiliary or ground power units supplying d.c. power for aircraft starting or servicing. When used as a ground power unit, the generator is attached to and driven by the motor of a "jeep" and the current is applied to the plane's starting motor, eliminating the need for batteries or other auxiliary source of energy in light aircraft.

Materials at Work

Here is materials engineering in action . . .

New materials in their intended uses . . .

Older, basic materials in new applications . . .

ALUMINUM INSULATION By adapting that most effective of all insulating principles—the use of parallel heat reflecting surfaces separated by nonconducting spaces—a new type of aluminum insulation for high temperature lines known as Mirror Insulation has been developed and patented by Hunter Manufacturing Corp.

Alcoa Aluminum sheet is combined in series with spacers to form sealed air chambers. Result is an attractive, quickly installed sheath for pipes, valves, fittings and ducts with temperatures ranging from 1050 F to —325 F. Inherently waterproof, Mirror Insulation requires no painting, can be wiped clean with a damp cloth.

VINYL PLASTIC REPLACES METAL IN INDUSTRIAL FILTER UNIT

Tough, corrosion resistant, rigid vinyl plastic is being used to replace expensive metal alloys in many essential parts of an industrial leaf-type filter used for filtering acids, according to the Hercules Filter Corp.

Filter leaf frames, nuts and bolts holding the leaves together, rollers which hold the leaves in place, the heel plate, and various pipe fittings are made from a rigid Geon vinyl plastic developed by B. F. Goodrich Chemical Co. The inside of the tank is also lined with a flexible vinyl sheeting to protect it from corrosion. Replacing settling tanks used by an automobile battery manufacturer, the filter is 40 in. in dia and contains 280 sq ft of filter screen.

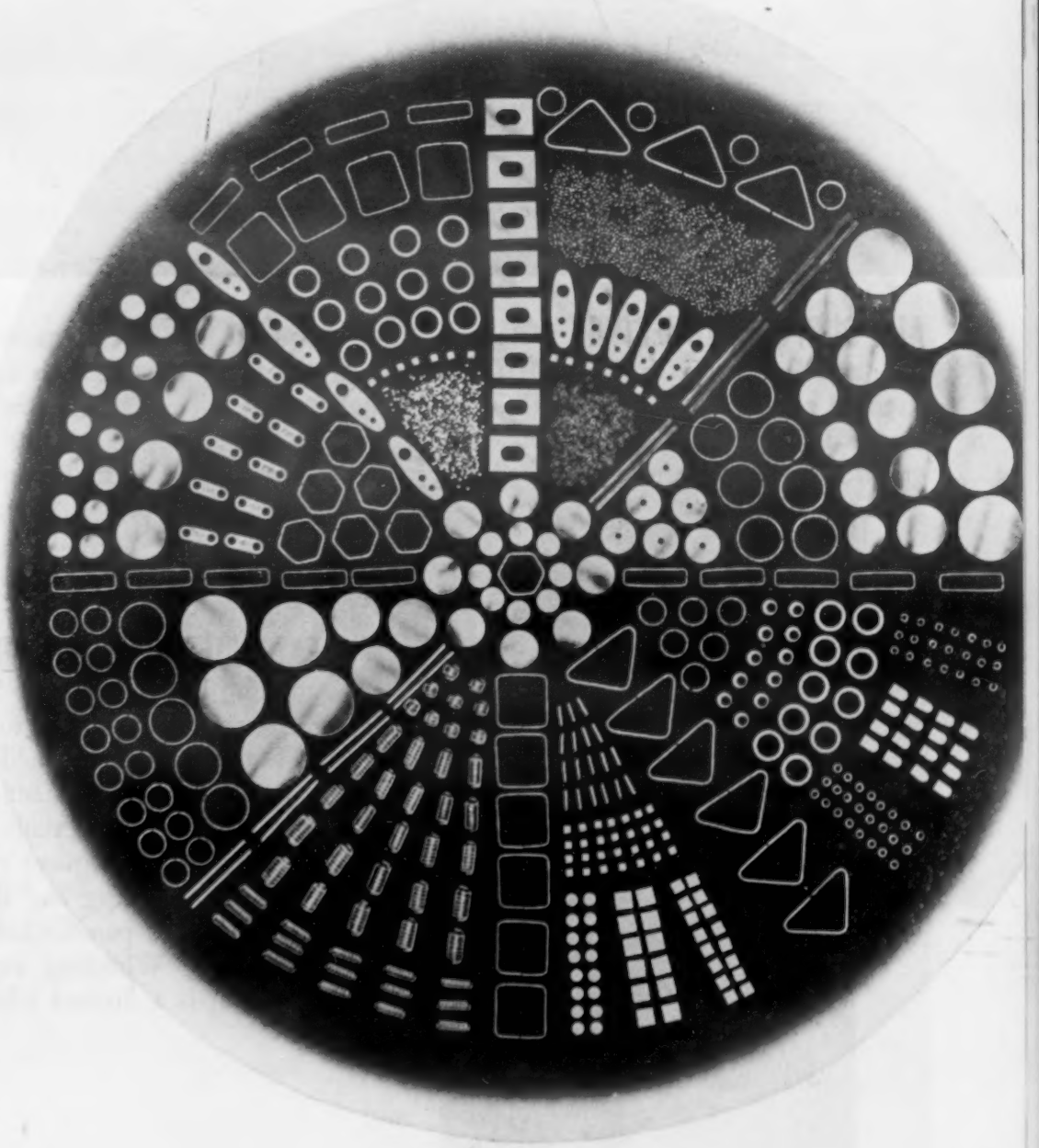
High corrosion resistance is the main reason why the vinyl plastic was tried in this application to separate a heavy manganese dioxide sludge from a hot solution of surfuric acid. The cost of the plastic is about 1/3 to 1/4 that of special metal alloys which would resist corrosion in this application.

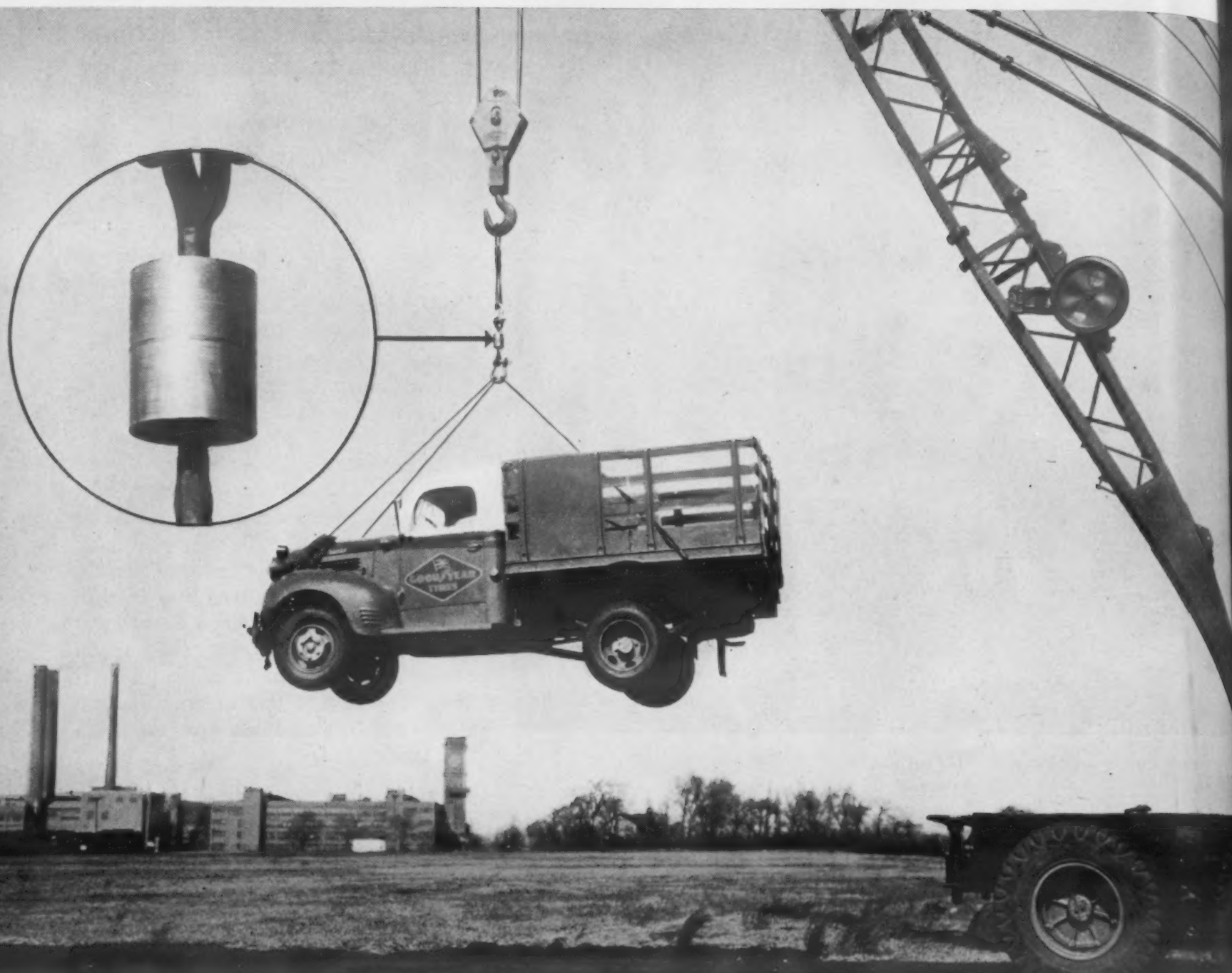
"SOLDERFORMS" USED IN GERMANIUM DIODES

Solderforms produced by Kester Solder Co. are playing a prominent part in the manufacture and end-use of germanium diodes. This particular application is another illustration of the widening industrial use of Solderforms by manufacturers to speed up production and cut down on waste and rejects. Solderforms comprise any desired tin-lead alloy, with or without a flux, and made up in any required shape such as a ring, disk, pellet, washer or spring. Other metal components can be included if required, as in the case of soldering germanium diodes, where silver is added to the basic alloy.

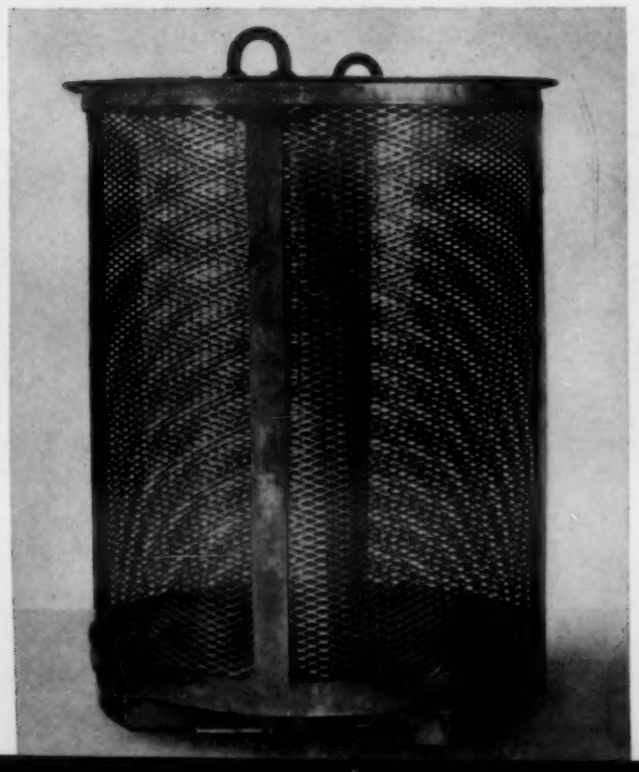
Any of the usually accepted methods of applying solder can be employed with "Solderforms," it is said. They can be soldered with flame, carbon resistance, oven, hot-plate, induction heating, infrared, or a conventional soldering iron.

A partial list of the many assemblies now using Kester Solderforms includes such electronic components as capacitors, resistors, switches and relays; gages; fire control parts; fuses; watch movements; badges and emblems; and cigarette lighters.





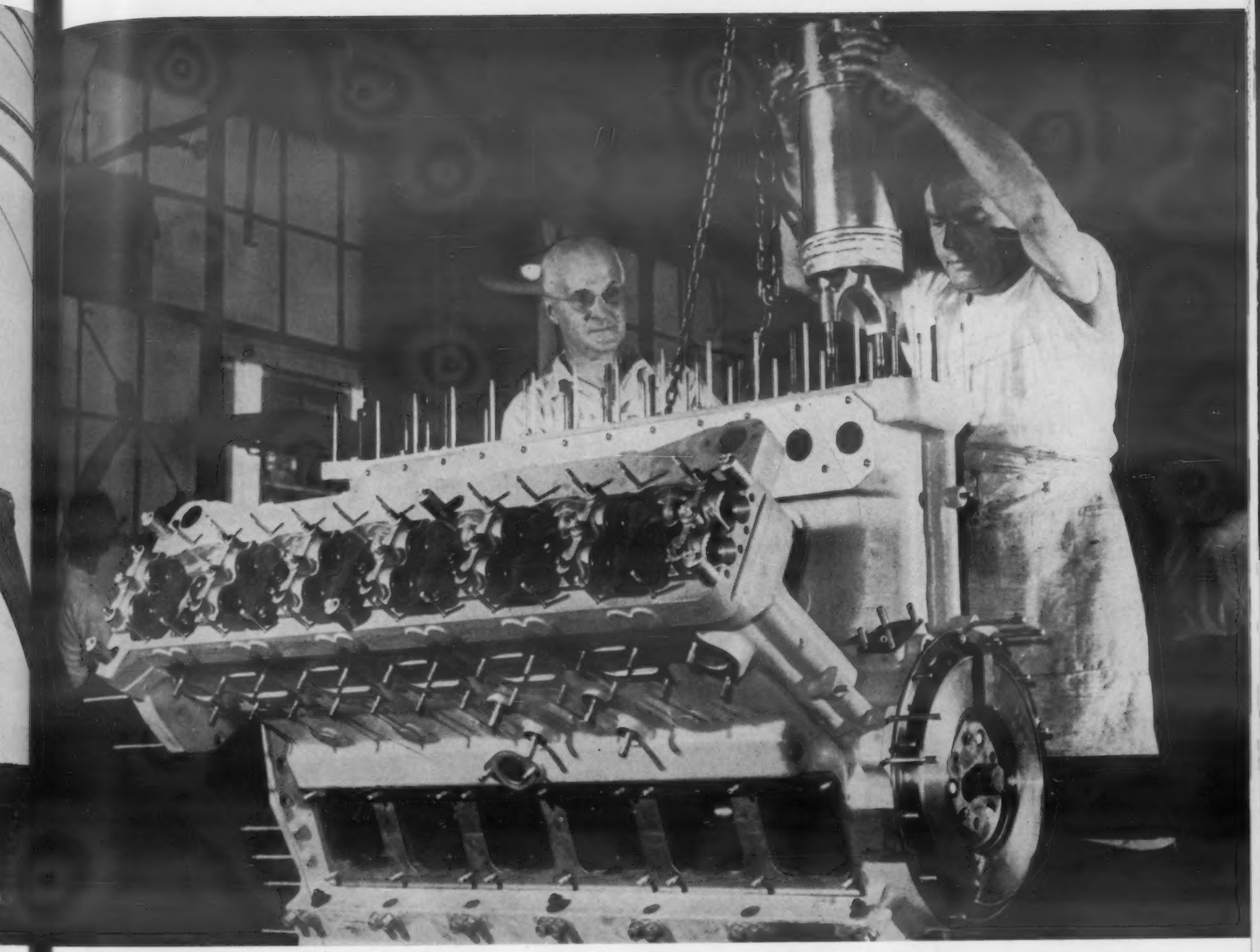
ALL PURPOSE ADHESIVE Recently, the Goodyear Tire and Rubber Co.'s Chemical Div. demonstrated the strength and versatility of its all-purpose adhesive, Pliobond. Two steel blocks, 4 in. in dia and with machine ground surfaces, were bonded together with Pliobond. As a connecting link in a lifting test, this unit swung a 5,000-lb truck high off the ground. Still bonded together, the same two blocks later supported a weight of 19,150 lb, or more than 1,500 psi in a laboratory tests.



EXPANDED METAL IMPROVES DEGREASING PROCESS This degreasing basket, made by Stanwood Corp., utilizes Wheeling Corrugating Co. expanded metal to provide maximum open area and penetration of liquid or air, combined with strength and durability.

According to the manufacturer, the smooth diamond pattern of the expanded metal prevents lodging of liquid and waste particles in corners with consequent reduction in size of openings.

Made by slitting and stretching solid steel sheet, of various gages, into one-piece panels that can be easily formed and welded to steel framework, Wheeling expanded metal has a high strength/weight ratio that is a distinct advantage in many such industrial applications.

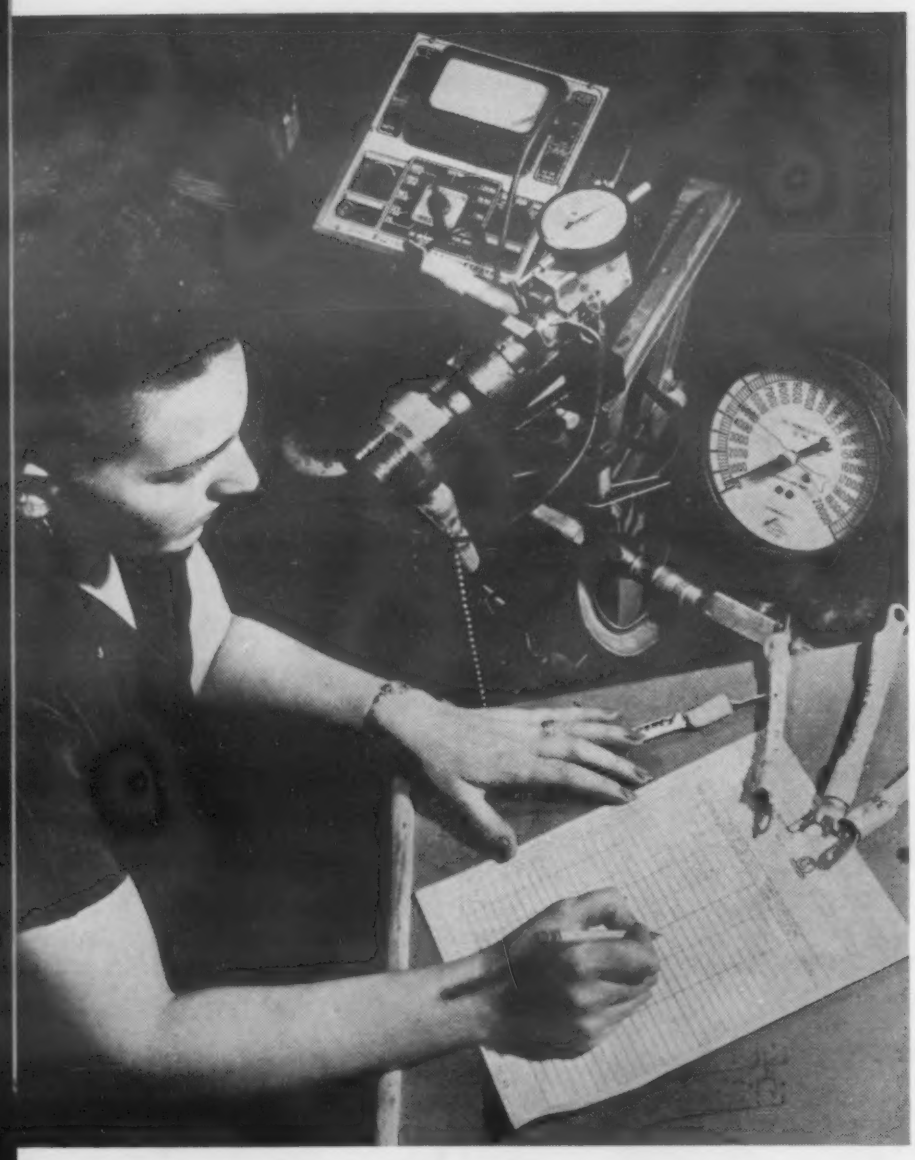


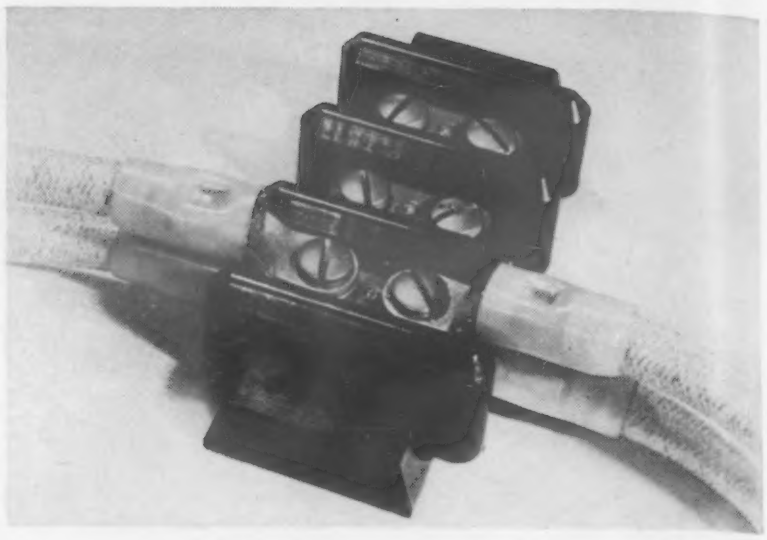
INVESTMENT CAST CYLINDER HEAD Cylinder heads for two new light weight diesel engines produced by the Packard Motor Car Co. indicate the size part which can be made by the precision investment casting process. The heads are about 7 in. in dia, 4 in. high, and weigh about 25 lb.

The Haynes Stellite Co. precision investment casting process is ideally suited for mass production of the cylinder heads. The process has made it possible to design this intricate part in a high-strength alloy with a minimum of machining. The process has also provided designers with the opportunity of producing the head as one integral part, eliminating extra assembly costs.

The investment cast heads are finish machined and then welded to the cylinder heads by Linde's sigma welding process.

Materials at Work





MOLDED NYLON TERMINAL INSULATION Five steps are eliminated in the installation of large aircraft cable by a new *Sta-Kon* terminal self-insulated with a nylon jacket, according to its manufacturer, the Thomas & Betts Co. The electrical fitting was developed for cable up to the largest specified size, 4/0. One aircraft maker estimates a saving of over $200 an airplane when self-insulated terminals in all sizes are substituted for non-insulated types on a new fighter.

Company engineers point out that the funnel-shaped interior of the nylon jacket's shroud automatically guides the many fine strands of aircraft cable into the terminal, insuring a well insulated joint with maximum electrical capacity and calling for minimum assembly time.

The shroud also serves as a support for the cable insulation extending its flexing over a large area. This reduces possible injury to the cable insulation by preventing concentration of flexing at one point.

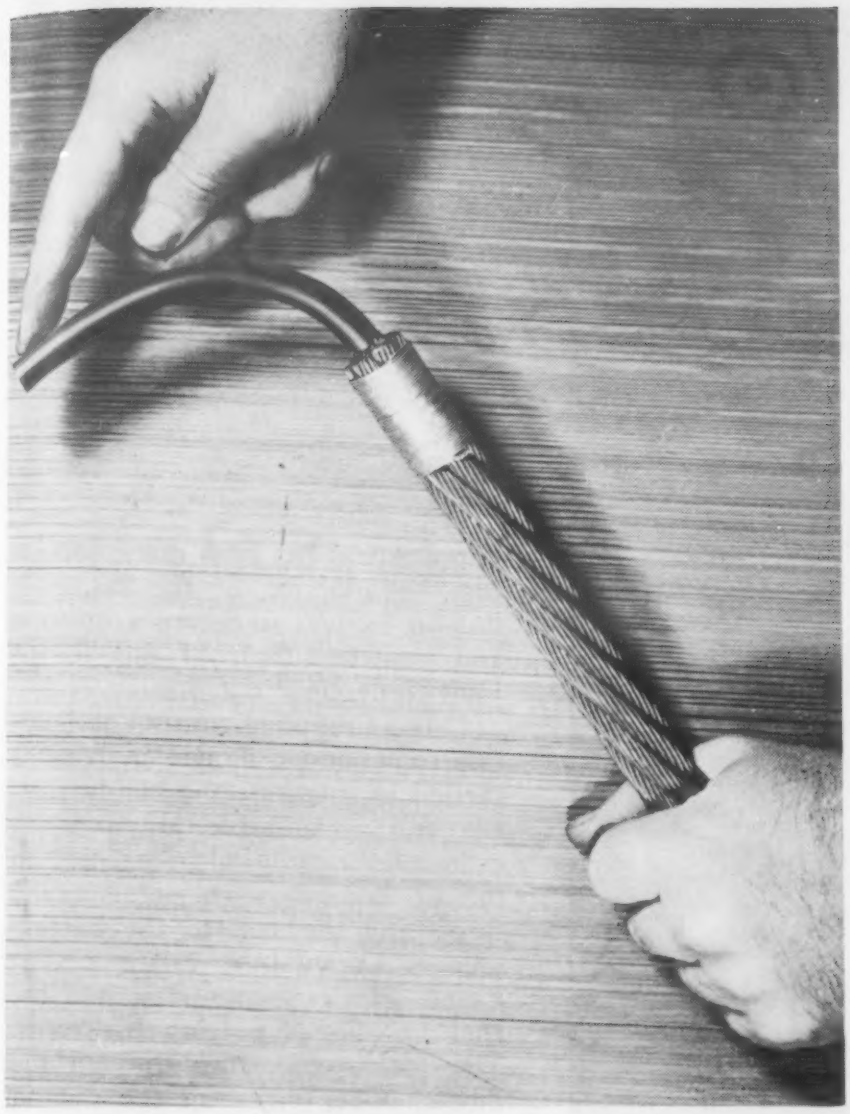
Nylon insulating jackets resist chemical action of aircraft hydraulic fluids as well as certain ketones found in them; they also resist aromatic oils and fuels and sulphonated oils often used in modern aircraft.

Another feature of the new fittings is their compactness, which permits electrical connections in restricted areas, where leads are crowded or overlap, as in airplane control wiring. By dyeing the nylon jackets, they can be color coded for size or circuit.

Tests show that 6000 volts can be applied to the staked area without puncturing the nylon insulation; most aircraft requirements call for only 1500 volts. Other advantages of the material are its resistance to high temperatures.

The new terminal's bronze barrel furnishes the mechanical strength to hold its copper tongue against the cable for optimum conductivity, and the nylon insulating jacket makes the terminal a complete unit.

ALUMINUM BRONZE SHAFT A hollow forged shaft of aluminum bronze produced by Ampco Metal, Inc., for marine work has a tensile strength of 110,000 psi, with a yield point of 50,000 lb and an elongation of about 18%. The shaft, 36 ft long and having an outside dia of about 8 in. and an inside dia of about 4¼ in., was forged from an ingot approximately 25 in. by 25 in. by 80 in., that weighed about 10,000 lb after cropping.



WIRE ROPE WITH PLASTIC CORE

A wire rope with a plastic core is being made by Jones & Laughlin Steel Corp. This rope was developed to replace fiber core wire rope in the drilling of many oil and gas wells. The plastic core is unaffected by the acids, caustics and other substances which destroy the fiber cores now being used. It will also be produced in this country instead of imported, as is the fiber for hemp cores. This would eliminate uncertainty of supply during periods of war or other international stress.

Other advantages include:

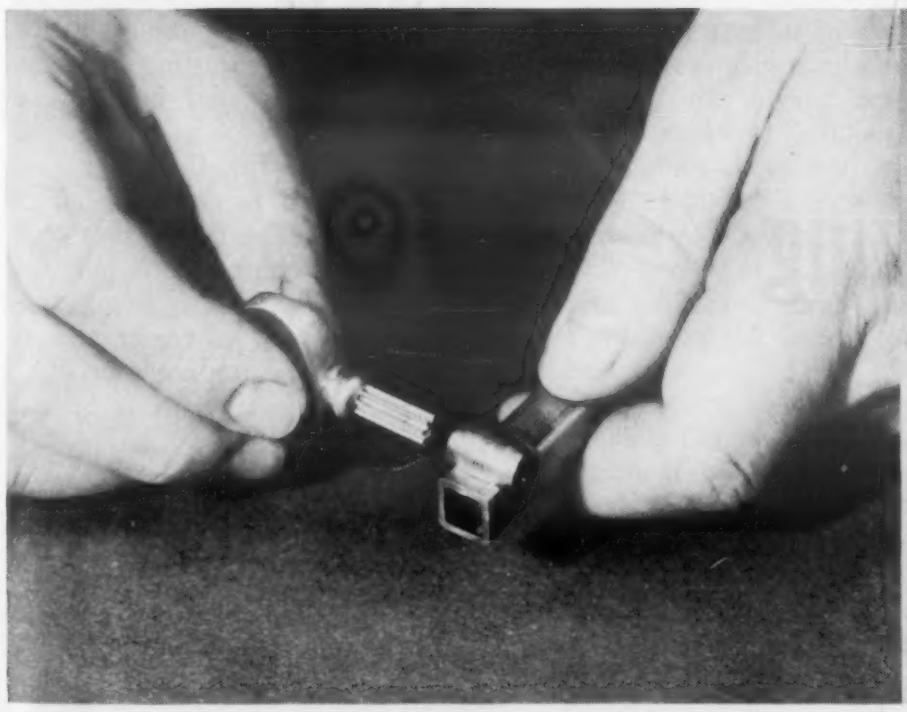
1. The plastic core is not affected by moisture. The hemp in the fiber core, however, needs a small amount of moisture to keep its resilience. Excess moisture promotes growth of fungus in the hemp.

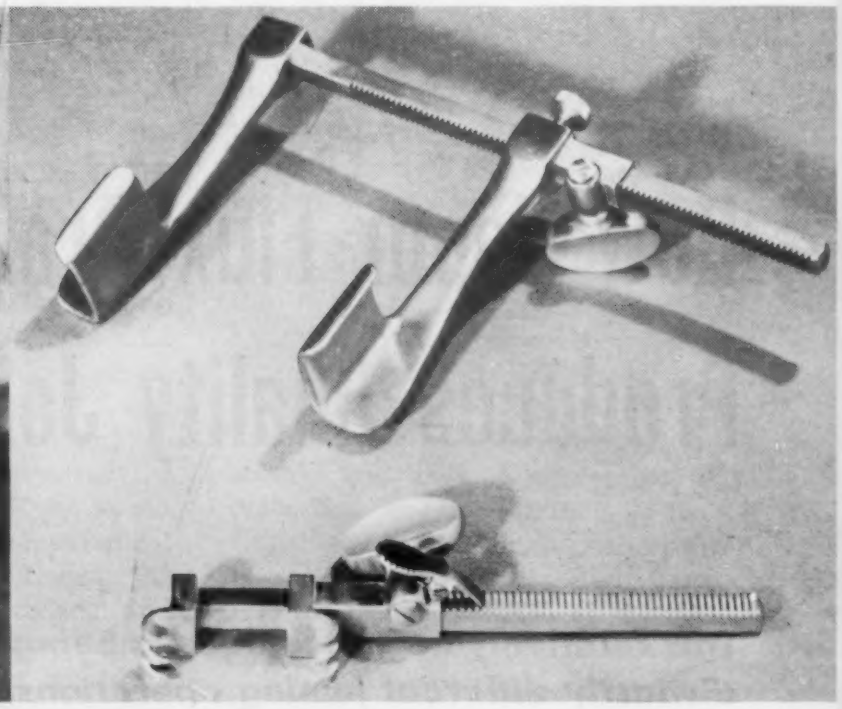
2. The plastic core maintains its resiliency. Fiber core's resiliency is maintained by moisture for only limited periods.

3. The joints in plastic core, produced by a kind of welding under heat, are homogeneous, with strength in the splice identical with that throughout the rest of the length. Joints in fiber core, made mechanically, are often weak spots.

4. Plastic core absorbs no water, so the steel of the rope is not subjected to rusting from that source.

5. Strength and toughness are uniform throughout the length of a polyvinyl plastic core.





SQUARE TUBING SIMPLIFIED SURGICAL INSTRUMENT DESIGN

Many of these instruments are made more efficient, and at less cost, with the help of fine small tubing such as is supplied by Superior Tube Co. Examples are the Tuffier Rib Retractor and the Bailey Rib Contractor made by George P. Pilling & Son, Inc. Design of the mechanism was made possible by the use of Superior's square stainless tubing.

Movement of the retractor blades or contractor claws is effected by a rack and pinion arrangement. Support for pinion rod is furnished by Superior's square stainless tubing, which is silver soldered into broached square opening in sliding arm. Pinion rod is pinned into thumb screw and silver solder: when thumb screw is turned, the sliding arm and attached square tubing move along the rack, thereby increasing or decreasing distance between blades or claws. Blades and rack must withstand the greatest strain; therefore they are made from the hardenable grades of the 400 series of stainless steels, which can be heat treated to required hardness. Other parts—square tubing, gear housing, pinion rod, etc.—are made from Type 304 stainless. Silver solder is used in all joining operations because it combines the desired physical properties with good corrosion resistance.

Bronze welding top corner joints of cabinet.

How Vapor Flux Brazing Produces Quality Joints

This relatively new technique is being used in two distinctly different joining operations. In both, rejects due to porosity have decreased and production rates increased.

by HAROLD S. CARD

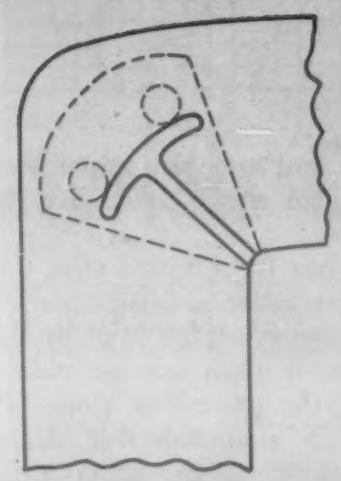
● DEVELOPMENT OF special torch brazing techniques which utilize vapor fluxing has helped to increase production rates and to decrease rejects due to porosity in the manufacture of household refrigerators at the Erie Works of General Electric Co. Two distinct types of brazing operations are involved in the assembly of the cabinets and of the refrigerating units. They are performed with different apparatus, different brazing materials and different techniques. But in both cases a distinct improvement has been noted following the adoption of the automatic fluxing method to secure a unifo.m and positive supply of flux to the joint throughout the brazing cycle.

Flux as supplied consists of properly compounded fluxing ingredients carried in solution in a highly volatile and inflammable liquid which evaporates rapidly when exposed to the air. Equipment for automatically dispensing the flux to the brazing area is a container, called a Gasfluxer, which is connected into the fuel gas line supplying the torch. The fuel gas passing through the flux chamber picks up the flux in vapor form and delivers it to the torch in the gas. The flux is in the flame and the proper amount to use can be secured by adjusting the regulating valve. The fuel gas can be acetylene, city gas or any other gas that is suitable for the work; no change needs to be made in either torches or tips. The flame takes on a brilliant green color, which tells the operator that the flux is being supplied to the work wherever and as long as the flame impinges on it.

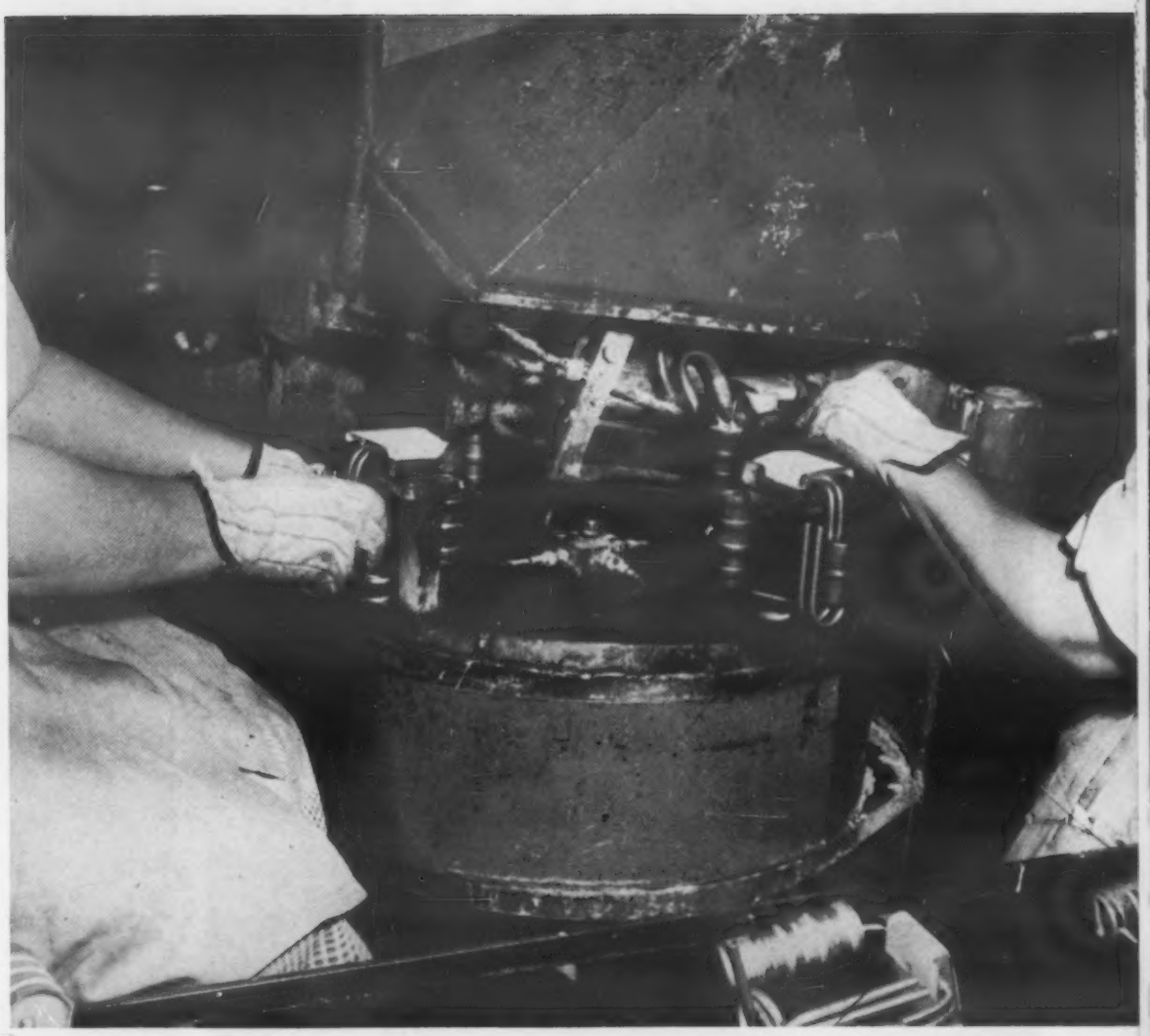
Brazing on Cabinets

On each refrigerator cabinet there are four joints to be brazed: two at the top front corners and two where the cross piece joins the sides. This brazing is done with the oxyacetylene flame and a bronze brazing rod, with all fluxing done by the flame.

Base material of the cabinet is furniture grade low carbon steel, 0.035 in. thick. The two sides and top are blanked and formed in a single piece. The blank is notched at the location of the top front corners so that after flanging and bending there is left at each of these corners a T-slot about 3/32 in. wide. Closure of this slot by brazing is aided by use of a back-up piece, or gusset, in the form of circular sector, stamped



Corner joint assembly. Broken line shows location of gusset.



Indexing fixture for bronze welding muffler assemblies.

from the same material as the cabinet. The gap, which is closed by brazing the cross piece to the sides, is provided with adequate backing in the parts themselves. This cross piece and other bracing members are spot welded solidly in place with gun welders while the cabinet is on its way to the brazing station.

The objective of the brazing operations at these locations on the front of the cabinet is to make possible the production of a smooth, solid surface around the perimeter of the door, free from wrinkles or porosities. Appearance is a factor, but even more important is the requirement that the refrigerator door must close tightly against this front flange. No waviness or pinholes can be tolerated. After the bronze welds have been finish ground, each cabinet is placed in a testing fixture to check the alignment of these surfaces. A cabinet which fails in the test usually has to be scrapped.

Oxyacetylene welding with steel filler rod had been tried on this application but was unsatisfactory because considerable grinding was needed to remove surplus metal from the weld bead. It was difficult to deposit a sufficient bead and obtain good fusion without throwing so much heat into the adjacent metal as to cause warping, and stresses imposed on the welds in the test block caused an appreciable amount of weld cracking. Brazing with bronze filler rod was adopted to reduce the heat input and make finish grinding easier.

To perform the brazing, the flame is passed along the joint as a preheating and prefluxing measure. The torch is oscillated to prevent overheating the bronze, which would cause the zinc in the brazing alloy to boil, leading to a porous deposit. Travel speed is held constant in order to achieve a uniform bead. The plate at the beginning of the joint is brought to a dull red heat (1200 F), being careful to avoid overheating, before depositing filler rod.

The four bronze welds are made simultaneously, each operator having to deposit about 2¼ in. of bronze bead. The small steel gusset which is inserted under the corner joint not only serves as a back-up piece but also adds considerable strength and rigidity to the corner because it is brazed solidly to the under side of the flange. The advantages of using the flux-bearing flame in this application are: better penetration of the brazing alloy, easier grinding, fewer rejects, and about 25% improvement in production. After final testing, the cabinet is cleaned, Parkerized and given a baked white enamel finish. Sections of typical cabinet welds are illustrated in an accompanying figure.

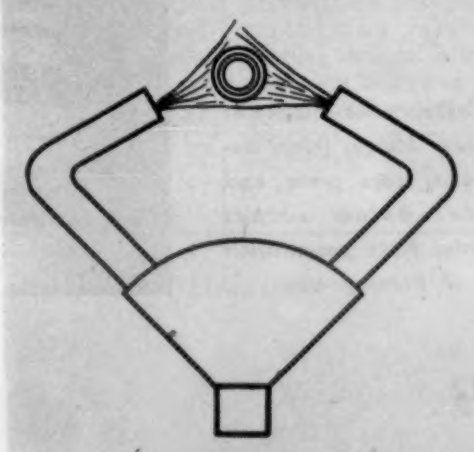
Brazing on Refrigerating Units

In the assembly of refrigerating units, joints are of the tube-within-tube type. When steel tubes are joined to steel tubes or to copper tubes, these are brazed with a silver brazing alloy, using both the vapor flux and a thin paste flux. Where copper-to-copper joints occur, they are brazed with a phosphorus-bearing silver alloy which requires no flux.

The torch used on tube joints is fitted with Style 729 multiple flame double tip (tip size 5 to 7) formed so that the two flames are directed toward each other (see accompanying sketch). In use, the torch is held so that the joint is midway between the two tips, and both sides are brought up to brazing temperature simultaneously. The torch burns high pressure city gas with oxygen. At each brazing station along the assembly line there is a container of paste flux and a Gasfluxer, with a two-stage chemical drying battery for drying the city gas before it passes into the flux chamber.

Before assembly, the male tube is

How double flame heats all around tube joint.



prefluxed with the Gasflux flame by oscillating the double tip torch lengthwise of the tube, somewhat in the manner of the paint brush, for a minimum of four times. The paste flux is brushed on after the joint is assembled. Both members of the joint are heated uniformly with a neutral flame so that both male and female parts reach temperature at the same time. When the joint has reached the brazing temperature, the brazing alloy is applied. The torch flame is removed from the female portion of the joint last in order to pull the brazing alloy throughout the joint.

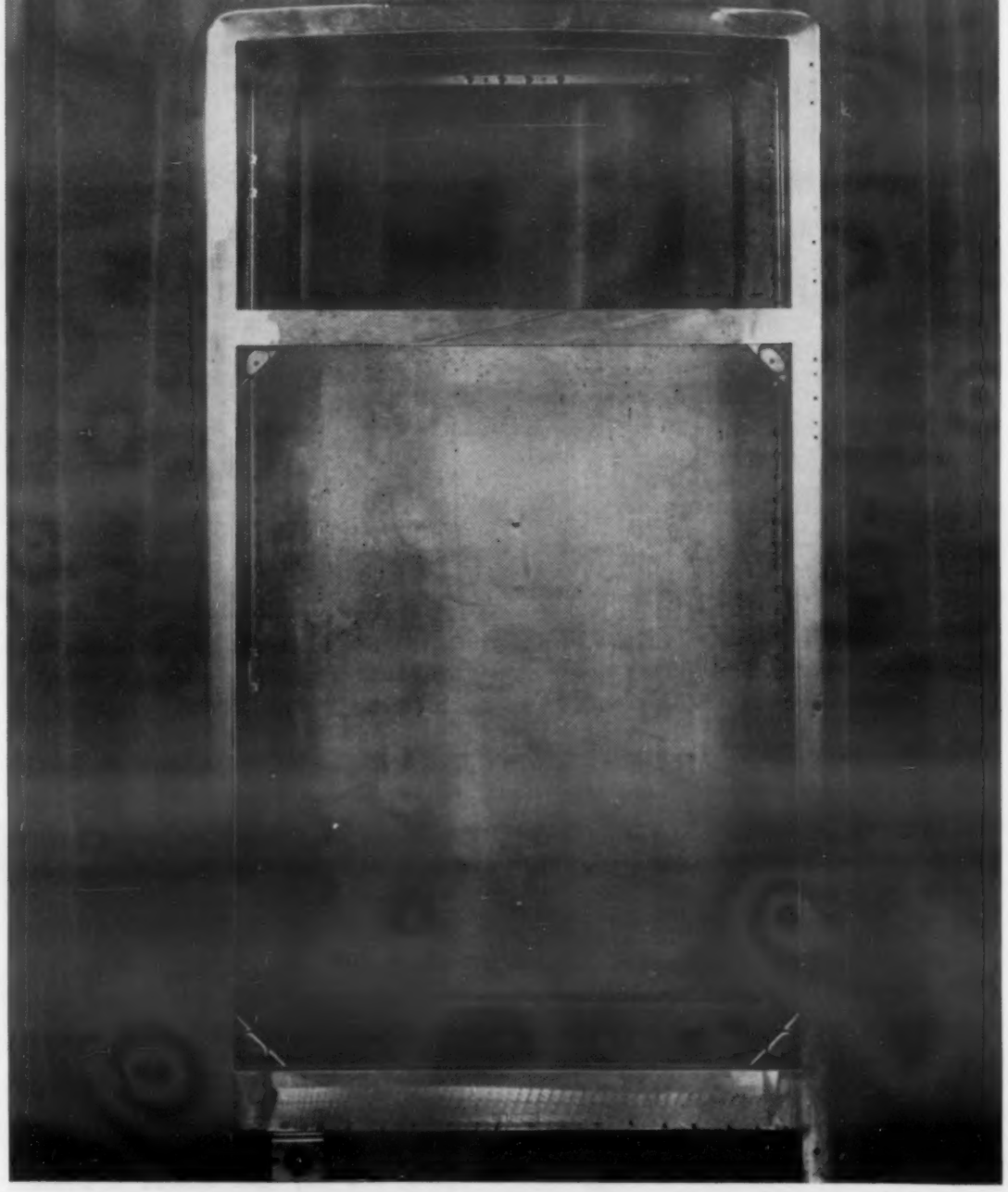
The brazed joint is not disturbed or artificially cooled until the alloy has completely solidified. After the braze has solidified, but before the joint is cool, it is scrubbed with a swab and water at a temperature of 180 F or above, to remove all traces of flux.

It has been found that this fluxing procedure results in much greater penetration of the joint by the brazing alloy than can be obtained by using the paste flux alone. This results in a considerable decrease in leakers when the units are tested. Explanation of the improvement lies in the better distribution of the flux. One of the functions of flux is to aid the flow of the molten brazing alloy into the joint. Flux will not flow ahead far enough into a close-fitting tube-within-tube joint and the alloy will only go as far as the flux goes. Prefluxing of the male tube induces the desired capillary action throughout the joint, thereby greatly reducing the incidence of porosity and consequent leakage. Another advantage of using the flux bearing flame in the brazing operation is that it prevents the formation of unsightly black oxide scale around the joint.

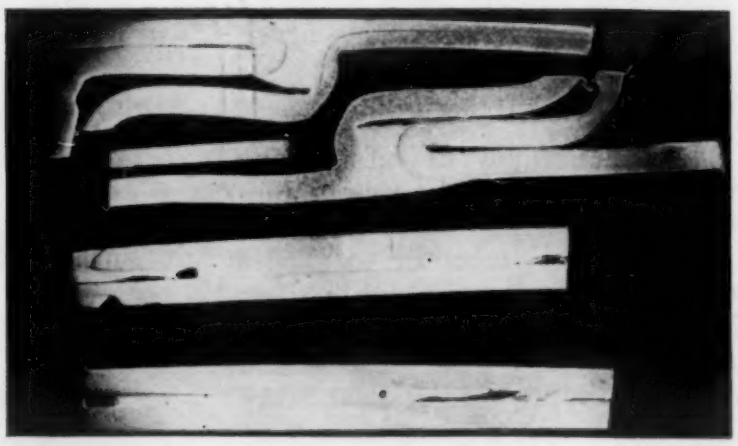
Most of the joints in the refrigerating unit require some manipulation of the brazing torch by the operator. An exception is the assembly of the muffle box and muffler. This is a matter of joining steel tubing to steel. The brazing operation is done in an indexing fixture. A special two-flame torch is mounted in a fixed position, so that rotation of the fixture brings the assembly into welding position under the flame, where it is held for a pre-determined time. Two operators are required at this station, one to load and unload the parts, and one to apply the paste flux and filler rod. When operating at a speed that would get best production from the set-up, it is necessary to use such high heat that the paste flux alone would burn out before the braze was completed, causing leaks.

When leaks are disclosed by routine inspection, it is necessary to disassemble the brazed joints. Again the flux-bearing flame is used to good advantage. When it is applied to the joint to melt the brazing alloy, allowing the tubes to be pulled apart, the flux prevents oxidation, leaving the parts clean and bright.

All of the procedures described here were developed in the Works Laboratory, tested and perfected before being used in production. They have been long enough in use to demonstrate that they are eminently suitable for the conditions. And they result in bronze welds which meet all requirements for strength, soundness, tightness and appearance.



Cabinet after finish grinding of bronze welds.



Sections of cabinet joints. Above, joints between cross piece and sides. Below, corner joints. Note penetration of brazing alloy.

PICTURE CREDITS: General Electric Co.

MATERIALS & METHODS
June • 1953
Number 253

Materials Engineering File Facts

Materials Data Sheet

Methyl Methacrylate Plastics

Methyl methacrylate is noteworthy for its transparency in clear form and its outdoor stability. Common trade names are Lucite and Plexiglass. It is available in water white transparent and a range of transparent, translucent and opaque colors.

	ASTM Test Conditions	Molding Powders		Cast Sheet
		Injection Molding	Compression Molding	
PHYSICAL PROPERTIES				
Specific Gravity	D792-48T	1.18–1.19	1.18–1.19	1.18–1.19
Thermal Cond, Btu/Hr/Sq Ft/In./F	(Cenco-Fitch)	1.4	1.4	1.4
Coeff of Exp, per F	D696-44	4–6 x 10^{-5}	4–6 x 10^{-5}	4–6 x 10^{-5}
Spec Ht, Btu/Lb/F	—	0.35	0.35	0.35
Refractive Index	D542-42	1.49	1.49	1.49
Luminous Transmittance, Illuminant C, 1/8 In., %	D791-49T	>91	>91	92
Haze	D1003-49T	<3	<3	1
MECHANICAL PROPERTIES				
Mod of Elast in Tension, Psi	D638-49T	4 x 10^5	4 x 10^5	3.5–3.8 x 10^5
Tensile Str, Psi	D638-49T	8700–9500	8700–9500	7000–8000
Elong in 2 In., %	D638-49T	3–10	3–10	2–7
Hardness, Rockwell	D785-48T	M87–105	M87–105	M90–102
Impact Str, Izod Notched (Ft-Lb per In. of Notch)	D256-47T	0.5	0.5	0.4
Mod of Elast in Flexure, Psi	D747-48T	3.4–4.3 x 10^5	3.4–4.3 x 10^5	3.7–4.3 x 10^5
Flexural Str, Psi	D790-48T	15,000–16,000	15,000–16,000	12,000–16,000
Compressive Stress at 1% Deformation	D695-49T	4600–4800	4600–4800	5000
ELECTRICAL PROPERTIES				
Elect Res, Microhm-Cm @ 68 F	D257-46	>10^9	>10^9	>10^9
Dielectric Str (Short Time) Volts/Mil	D149-44	400–500	400–500	400–500
Dielectric Constant:				
60 Cycles	D150-47T	3.5–3.9	3.5–3.9	4.5
1,000,000 Cycles	D150-47T	2.7–3.2	2.7–3.2	2.7–3.2
Power Factor:				
60 Cycles	D150-47T	0.04–0.05	0.04–0.05	0.05
1,000,000 Cycles	D150-47T	0.02–0.03	0.02–0.03	0.02–0.03
Loss Factor:				
60 Cycles	D150-47T	0.14–0.23	0.14–0.23	0.17–0.27
1,000,000 Cycles	D150-47T	0.05–0.10	0.05–0.10	0.05–0.10
FABRICATING PROPERTIES				
Injection Molding Pressure, Psi	—	10,000–30,000	—	—
Compression Molding Pressure, Psi	—	—	2000–3000	—
Injection Molding Temp, F	—	400–475	—	—
Compression Molding Temp, F	—	—	300–375	—
Forming Temp, F	—	—	—	280–350
CORROSION RESISTANCE	—	Stable in sunlight and under outdoor exposure; resistant to nonoxidizing acids, dilute alkalies alphatic hydrocarbons; attacked by concentrated alkalies, oxidizing acids, ketones, esters, aromatic and halogenated hydrocarbons.		
USES	—	Aircraft components; electrical components; lighting fixtures, decorative trim; functional automobile parts; indoor and outdoor signs.		Aircraft enclosures, machining safety guards; windshields, portholes for boats; demonstration models; chemical equipment, decorative applications.
	—			

Prepared with the assistance of E. I. du Pont de Nemours & Co., Inc. and Rohm & Haas Co.

In Textiles Too, the Trend's to Phenolic Laminates Made with

PLYOPHENS

Textile machine makers have long sought a material that could combine various properties as needed in equipment parts . . . a material possessing such qualities as light weight, structural strength, dimensional stability under the highly humid conditions of textile manufacture, chemical resistance to corrosive sizes, a smooth surface to prevent snagging synthetic yarns.

Rod, sheet and tube stock made of fibrous material bonded with phenolic laminating varnish readily meets any or all of these requirements. More and more textile machinery companies are discovering this fact every day.

To help laminators profit from today's trend to phenolic laminates, RCI provides a complete line of PLYOPHEN varnishes.

If your application is unusual, chances are RCI can develop the varnish you require . . . through its pilot plant resin-making facilities and laboratory laminating equipment — and its complete testing facilities.

Your initial experiences with RCI PLYOPHENS will demonstrate their phenomenal treating machine yields, faster curing, greater moisture resistance, better electrical and mechanical properties, and lower stack losses. You'll get speedy service too, for eleven RCI plants dot the country coast to coast.

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Synthetic Resins • Chemical Colors • Phenolic Plastics • Phenol
Glycerine • Phthalic Anhydride • Maleic Anhydride
Sodium Sulfate • Sodium Sulfite

MATERIALS & METHODS
June • 1953
Number 254

Materials Engineering File Facts

Materials Data Sheet

Titanium, Molybdenum, Zirconium and Hafnium

These metals are recent additions to the metals available in ductile form. Titanium and molybdenum are in limited commercial use. Zirconium is used at present chiefly in AEC applications. Hafnium has no present commercial applications.

	Titanium	Molybdenum	Zirconium	Hafnium
PHYSICAL PROPERTIES				
Density, Lb/Cu In.	0.16	0.37	0.24	0.47
Melting Point, F	3135	4760	3355	3400
Thermal Cond, Btu/Hr/Sq Ft/Ft/F, @ 212 F	8.1	84	9.6	—
Coeff of Exp per F: at 70 F	5.0×10^{-6}	3.0×10^{-6}	3.1×10^{-6}	3.4×10^{-6}
Spec Ht, Btu/Lb/F:	0.13	0.061	0.069	0.035
Elect Res, Microhm-Cm @ 68 F	60	5.2[a]	40	30[a]
MECHANICAL PROPERTIES				
Mod of Elast in Tension, Psi	15×10^6	42×10^6	14×10^6	20×10^6
Tensile Str, 1000 Psi:				
Annealed	65–110[b]	85–130[c], 88[d]	29[e], 59[f]	—
Cold Worked	125–190[b]	120–175[c]	82[e], 90[f]	—
Yield Str, 1000 Psi				
Annealed	48–95[b]	—	11[e], 38[f]	—
Cold Worked	110–160[b]	—	58[e], 84[f]	—
Elong in 2 In., %				
Annealed	17–26[b]	4–7[c], 42[d]	26[e], 27[f]	—
Cold Worked	6–12[b]	1[c]	1.5[e], 10[f]	—
Hardness, Rockwell:				
Annealed	B80–98[b]	B95[c]	B42[e], B91[f]	B78[g]
Cold Worked	—	C22–27[c]	B87[e], B98[f]	—
THERMAL TREATMENT				
Annealing Temp, F	1100–1300	Anneal to specified mechanical properties	1550-heavy sections in air, light sections in vacuum or inert atmospheres	1380-in vacuum or inert atmospheres
FABRICATING PROPERTIES	Cold for most operations. Heated to 300 to 500 F for difficult forming.	Thin sheet cold. Other material by hot working methods.	Similar to titanium.	Hot worked at 1550 F, cold worked 30% between anneals.
Machining	Can use tools suitable for 18:8 stainless.	Similar to SAE 1040 steel heat treated to Rockwell 30.	Similar to titanium.	Similar to stainless steel.
Joining	Resistance or inert arc welding methods.	Generally by riveting or brazing. Thin sheets can be resistance welded.	Arc or flash-butt welded under inert atmospheres.	—
CORROSION RESISTANCE	Excellent resistance to chlorides and oxidizing acids such as nitric and aqua regia. Resistance to dilute hydrochloric and sulfuric acids and dilute alkalies. Particularly resistant to attack by sea water.	Moderately resistant to sulfuric, hydrochloric, hydrofluoric acids and the alkalies. Dissolved by dilute nitric acid or a mixture of hydrofluoric and nitric acids.	Excellent resistance to hydrochloric acid in all concentrations. Resistant to dilute sulfuric acid, to nitric acid in all concentrations and to the alkalies attacked by aqua regia.	Resistant to oxidizing acids but attacked by hydrofluoric acid.
AVAILABLE FORMS	Plate, sheet, strip, forgings, tubing, wire, special shapes.	Bars, sheet, wire, tubing, powder.	Sheet, rod, tubing, shapes.	Has been produced in sheet and rod.
USES	Aircraft applications, marine applications, chemical process equipment.	Electrodes for glass melting, electronic tube components, heating elements for high temperature electric furnaces, spark gaps, electrical contacts.	AEC applications. Probable future use for corrosion resisting equipment, particularly for handling hydrochloric acid.	No applications have been developed.

FOOTNOTES:

(a) *32 F.*
(b) *Depending on purity.*
(c) *From powder.*
(d) *Arc melted.*
(e) *Iodide zirconium.*
(f) *Kroll zirconium, melted in graphite.*
(g) *As deposited iodide hafnium.*

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Whether you need a replacement part or a component for new equipment . . .

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Inco gives you any size casting in any practical shape, of any weight from ounces to tons. Even castings you previously thought impractical to produce in Monel®, Nickel or Inconel® can often be cast by Inco's specialists.

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Consult your Distributor of Inco Nickel Alloys for the latest information on the availability of Inco Castings. Remember, too, it always pays to anticipate your requirements well in advance.

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Inco Castings *SAND, CENTRIFUGAL, PRECISION*

MATERIALS & METHODS
June • 1953
Number 255

Materials Engineering File Facts

Materials Data Sheet

Tungsten, Tantalum, Columbium and Vanadium

Tungsten and tantalum are established in their respective fields and are widely used commercially. Columbium is used chiefly as an alloying element in the stainless steels, but has limited commercial applications also. Vanadium, most recent of the group to be obtained in ductile form, is limited at present to AEC applications.

	Tungsten	Tantalum	Columbium	Vanadium
PHYSICAL PROPERTIES				
Density, Lb/Cu In.	0.70	0.60	0.31	0.23
Melting Point, F	6152	5425	4380	3110
Thermal Cond, Btu/Hr/Sq Ft/Ft/F, @ 212 F	96	32	—	—
Coeff of Exp per F: at 70 F	2.2×10^{-6}	3.8×10^{-6}	4.0×10^{-6}	4.8×10^{-6}
Spec Ht, Btu/Lb/F:	0.032	0.036	0.065	0.12
Elect Res, Microhm-Cm @ 68 F	5.5 (32 F)	12.4	13	25
MECHANICAL PROPERTIES				
Mod of Elast in Tension, Psi	50×10^6	27×10^6	—	20×10^6
Tensile Str, 1000 Psi:				
Annealed	—	50–100	48–59	72
Cold Worked	70–300	110–180	96–130	113
Yield Str, 1000 Psi:				
Annealed	—	—	—	64
Cold Worked	—	—	—	109
Elong in 2 In., %				
Annealed	—	11–40	30	28
Cold Worked	0–2	1–1.5	1	3
Hardness, Rockwell:				
Annealed	—	E60	—	B81
Cold Worked	C40–C67	E95	—	B93
THERMAL TREATMENT				
Annealing Temp, F	1830 protective atmosphere.	1950 in vacuum.	1950 in vacuum.	1650 in vacuum or inert atmosphere.
FABRICATING PROPERTIES	Must be hot worked in all but finest wires.	Must be cold worked.	Must be cold worked.	Good cold working properties.
Machining	Difficult; abrasive wheel cutting recommended.	High-speed steel tools at high cutting speeds.	Tools similar to those for steels.	Tools similar to those for cold rolled steel.
Joining	Braze with high temperature brazing alloys. Weld by resistance methods or inert arc welding.	Weld by resistance methods preferably under water. Inert arc welding with special procedures.	Resistance welding preferably under water.	Welded with heliarc torch under argon.
CORROSION RESISTANCE	Up to 212 F resistant to most acids and alkalies. Rapidly attacked by mixture of hydrofluoric and nitric acids at room temperature and by aqua regia at 212 F.	Resembles glass more closely than other metals. Inert to practically all acids but hydrofluoric fuming sulfuric and mixture of hydrofluoric and nitric at room temperature. Less resistant to alkalies.	Less resistant than tantalum but practically unattacked at room temperature by most acids excepting hydrofluoric. Less resistant to alkalies.	Resistant to sea water. Not affected by moderate concentration of hydrochloric and sulfuric acids. Dissolved by nitric acid of any strength.
AVAILABLE FORMS	Bars, sheet, rod, wire, powder.	Sheet, rod, wire, tubing, powder, fabricated shapes.	Sheet, rod, wire, powder, fabricated shapes.	Plate, strip, bars, sheet, wire.
USES	Lamp filaments, electronic parts, welding electrodes, alloying element in ferrous and nonferrous alloys.	Heat exchangers, coils, heaters especially for processing chlorine, hydrochloric acid, nitric acid; electronic applications, surgery.	Electronic tubes, rectifiers for low voltage a.c. alloying element in stainless steels.	AEC classified applications.

Cast in One Piece... in Stainless

to resist corrosion

STAINLESS STEEL IMPULSE WHEEL. Buckets in this one-piece casting are accurately spaced through proper alignment of cores. Wall sections are held to close limits to maintain balance, and buckets are polished for maximum efficiency of wheel. Diameter: 4'-2". Weight: 2200#.

Produced by EMPIRE STEEL CASTINGS, INC., Reading, Pa., for S. MORGAN SMITH COMPANY, York, Pa.

Corrosion meets its master in this impulse wheel of cast austenitic stainless steel containing 19 percent chromium and 9 percent nickel...

Furthermore... in hydroelectric power generation, under the terrific impact of a "high head" of falling water... this *stainless* casting tends to work harden while putting water to work, thereby improving its resistance to erosion and abrasion.

Impulse wheels are only one of countless applications in which advantage may be taken of the various useful properties of chromium-nickel stainless steels.

You can trim bulk and deadweight by specifying correct types of stainless. Strong and tough, stainless steels resist wear and attack by nearly all oxidizing acid conditions. Moreover, complexity of design is not a limiting factor in casting chromium-nickel stainless.

Austenitic stainless steels resist creep, scaling and oxidation at elevated temperatures. And at sub-zero temperatures, they offer exceptional resistance to impact.

Investigate all the economies you may obtain by using stainless steel equipment. Send us your inquiries on the use of cast or wrought stainless alloy steels. Write us details of your problems for our suggestions.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

EMBLEM OF INCO SERVICE

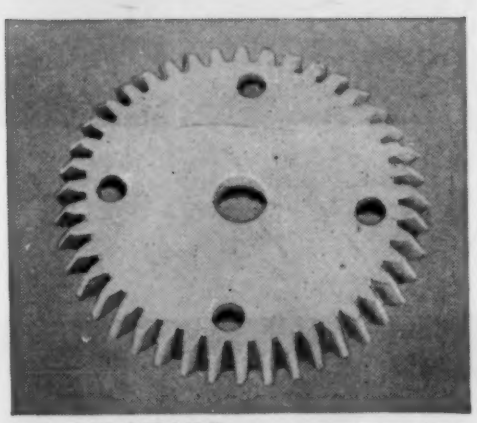
THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

# of Du Pont nylon plastic new fare collector

The Grant Electrofarer is a completely automatic fare-collection device . . . gives drivers an audible count and visible check of coin deposits. It can receive a single- or multiple-coin fare deposited in any combination of up to five coins and tokens, record the amount, then separate and drop each coin into its change carrier. It eliminates all driver fare handling except making change . . . contributes to safer, faster service.

The device incorporates 54 different parts of Du Pont nylon plastic. These parts (a few are illustrated) show how the engineering properties of Du Pont nylon can contribute to better product performance, often at less cost.

The parts were molded from Du Pont nylon by The Danielson Mfg. Co., Danielson, Conn., for Grant Money Meters Co., Providence, R. I.



NYLON GEARS can *operate continuously to 250°F.* . . . are readily molded in one operation . . . cut costs.

Du Pont nylon parts can be economically mass-produced by injection molding . . . are light in weight . . . give better performance. Nylon molding powders are available in a number of compositions, each with different properties, for mechanical, electrical and other uses. For information, write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 116 Du Pont Bldg., Wilmington, Delaware.

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SYNTHANE · GAMBLE BROTHERS · HESS GOLDSMITH · AMPCO METAL

28	29-B	29-A	30

27 INDUSTRIAL X-RAY	31			33	34	35

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MT. VERNON WOODBERRY MILLS 43	SOUTH FLORIDA TEST SERV. 44	REYNOLDS METALS 45	NORTON CO. 46	GENERAL CERAMICS & STEATITE 47	FIRESTONE PLASTICS 48
50 OWENS-CORNING FIBERGLAS			51 MEEHANITE METALS	52 BAKELITE	

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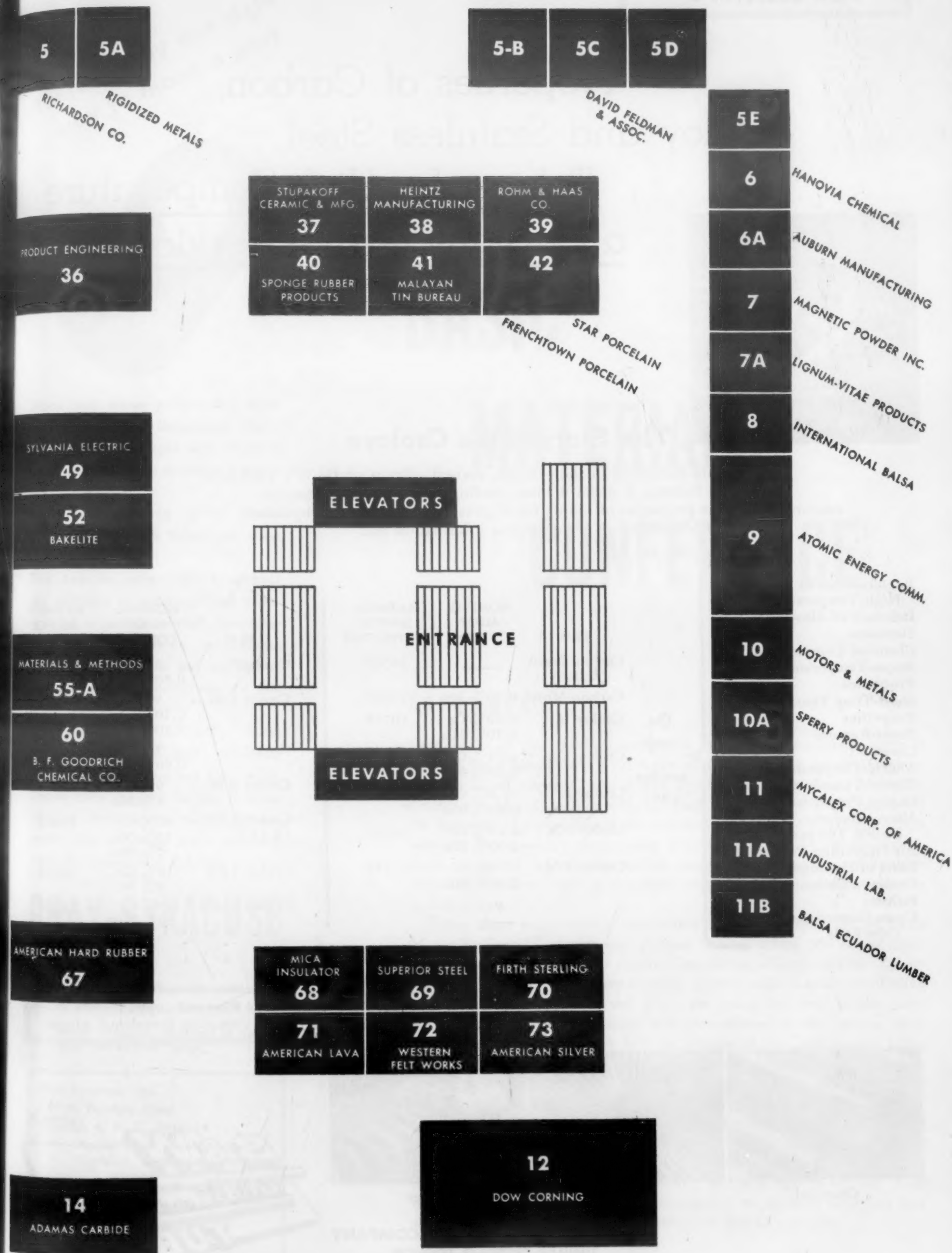
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B&W BULLETIN 6

Properties of Carbon, Alloy and Stainless Steel Tubing for High-Temperature and High-Pressure Service

The Story of the Croloys

New data contained in the seventh, revised edition of B&W's Technical Bulletin 6 make it must reading for technical personnel concerned with the properties of tubing for high-temperature and high-pressure service. TB-6 contains up-to-the-minute information on:

- Requirements of Tubing for High-Temperature Service
- Influence of Alloying Elements
- Chemical Composition
- Room-Temperature Properties
- Short-Time Tensile Properties
- Stress-Rupture
- Creep
- Thermal Expansion
- Thermal Conductivity
- Impact Properties
- Microstructure—Transformation Temperatures
- Air-Hardening Properties
- Effect of Hydrogen
- Common Causes of Tube Failures
- Upset, Formed and Machined Tube-Ends

On such grades as

B&W	NOMINAL ALLOY CONTENT	MAXIMUM SERVICE TEMPERATURE
Carbon Steel (Killed)	——	1050F
Carbon-Moly	0.50% Mo	1050F
Croloy ½	0.60% Cr 0.50% Mo	1075F
Croloy 1¼	1.25% Cr 0.50% Mo	1100F
Croloy 2	2% Cr 0.50% Mo	1150F
Croloy 2¼	2.25% Cr 1.00% Mo	1175F
Croloy 3-M	3% Cr 0.90% Mo	1175F

B&W	NOMINAL ALLOY CONTENT	MAXIMUM SERVICE TEMPERATURE
Croloy 5	5% Cr 0.50% Mo	1200F
Croloy 5-Si	5% Cr 0.50% Mo 1.50% Si	1300F
Croloy 7	7% Cr 0.50% Mo	1250F
Croloy 9-M	9% Cr 1% Mo	1300F
Croloy 16-13-3	16% Cr 13% Ni 3% Mo	1600F
Croloy 18-8	18% Cr 8% Ni	1600F
Croloy 25-20	25% Cr 20% Ni	2100F

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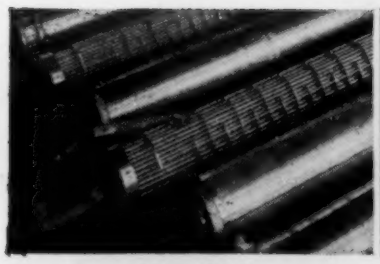
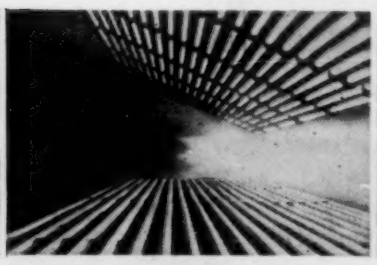
—on company letterhead, please.



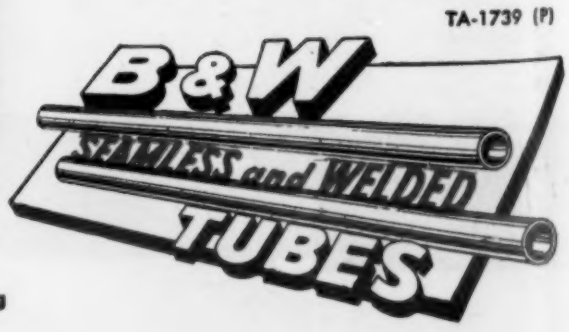
Chemical



Oil

Power

TA-1739 (P)



THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

There is only one right way to make a part

More and more progressive firms are finding that Investment Casting is often the right way to make small parts having multiple machining operations.

Investment Casting gives sound parts with smooth finish and close tolerances.

This can be accomplished without the difficulty of securing sized materials on a scarce market, excessive scrap losses or tying up machine time that could be put to better use on parts not adaptable to this process.

Illustrated part weighing three ounces is cast of #410 Stainless Steel. It is 2¼" long and 1½" wide. Check with us now to see if some of your small ferrous or non-ferrous parts can be made more economically by Investment Casting.

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Syracuse 4, N. Y., Dept. "A"

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BASIC MATERIALS CONFERENCE

Foreword

In this era of fast moving changes in engineering materials, there is a need for a forum where all types of materials can be discussed in relation to all others. Thus, it was decided to hold a Basic Materials Conference in conjunction with the First Exposition of Basic Materials for Industry. In establishing the conference and selecting the program subjects and speakers, the primary consideration was to provide sound, basic, practical information on all engineering materials. Particular attention has been paid to the most pressing problems facing industry at the moment.

Today there is increasing competition among materials for all kinds of applications. Ceramics and plastics, among others, are taking their places along with metals for applications having difficult service requirements. The newer metals are fighting to push aside the old established metals. In addition, irons and steels are being improved to the point where they must be reexamined and reconsidered in the light of their new and improved properties. It is the purpose of the Conference to bring many of these changes in status to the attention of engineers charged with designing and producing all kinds of products from toy trains to steam turbines and jet engines.

During the next few years the demands for knowledge of engineering materials to meet the problems of jet propulsion and atomic energy utilization will be tremendous. Couple these demands with those created by the normal developments of industry, and it is easy to see why those charged with the selection and application of engineering materials face constant challenges to their resourcefulness and imagination.

T. C. Du Mond, *Editor, Materials & Methods, General Chairman.*

ALSiMAG®

AlSiMag does not rust, oxidize or corrode.

AlSiMag is chemically inert.

If you are interested in resistance to wear, resistance to heat shock, chemical resistance, permanent rigidity, controlled porosity, or dimensional accuracy in a non-magnetic material which does not rust, corrode, carbonize or deteriorate . . . and which can be fabricated to your specifications . . . *investigate AlSiMag!*

VISIT BOOTH NO. 71

EXPOSITION of BASIC MATERIALS FOR INDUSTRY

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AMERICAN LAVA CORPORATION, Chattanooga 5, Tennessee

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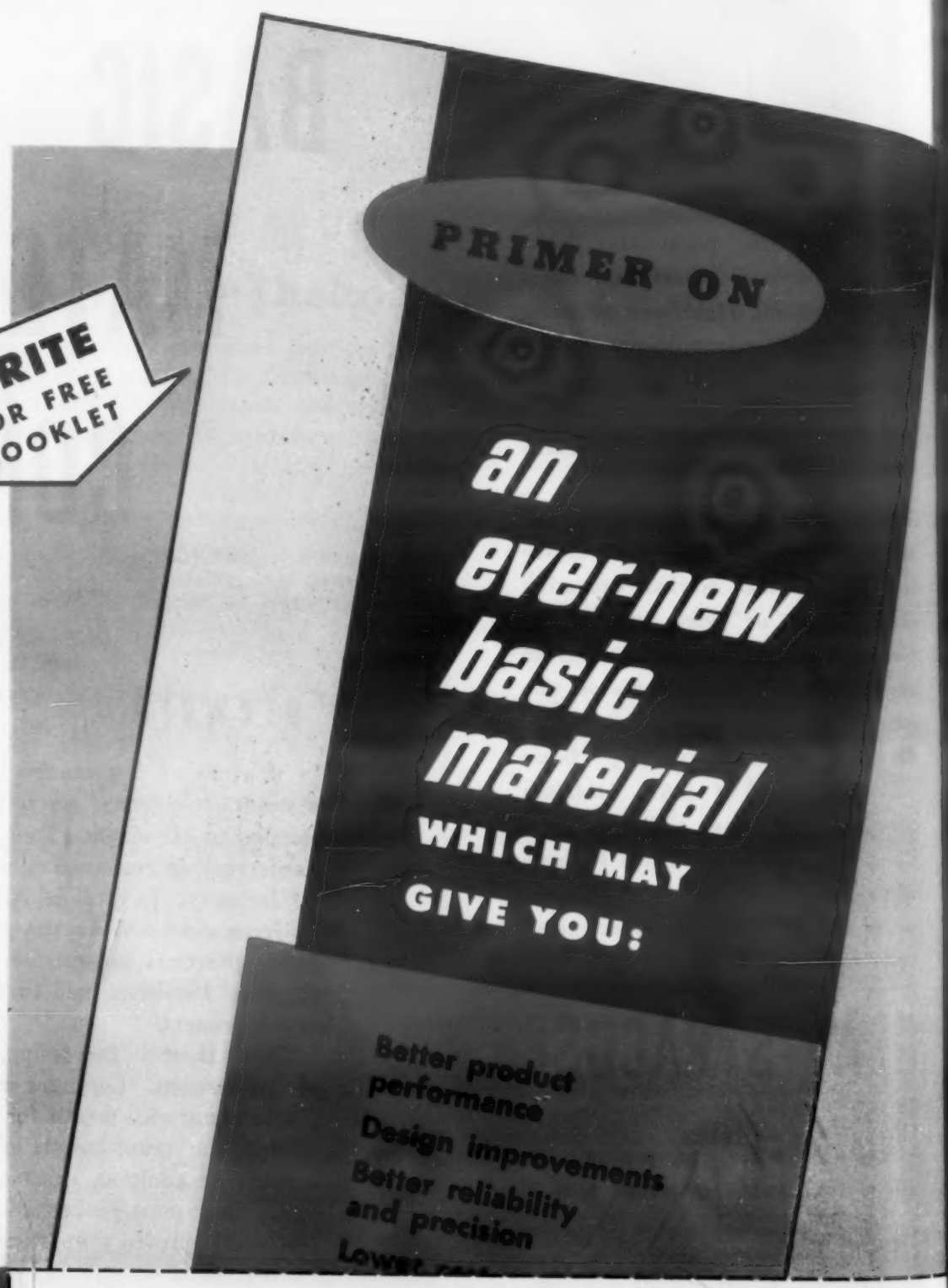

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Gentlemen: Please send, without obligation, my copy of the "Primer On An Ever-New Basic Material."

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Program

ALL SESSIONS TO BE HELD IN BALLROOM, HOTEL ROOSEVELT

Tuesday, June 16

10:00 A.M.

Subject:
Economics of Engineering Materials

Chairman: **T. C. Du Mond, Editor,** *Materials & Methods.*

The President's Report on Materials, known widely as the Paley Report, called attention to the coming problems in materials supplies. What are some of these problems? What can we do to prevent materials famines? What effect will the new materials have on the overall supply problem? These and many other questions of similar importance will be discussed by two men who have studied the situation closely.

Papers:

"Materials and The Future"—**Eric Hodgins,** *Board of Editors, Fortune*

"New Materials and What They Will Mean to Industry"—**J. J. Harwood,** *Metallurgical Div., Office of Naval Research, Washington, D. C.*

Question and Discussion Period

2:30 P.M.

Subject:
Progress in Materials (No. 1)
Materials for High Strength with Low Weight

Chairman: **Thomas E. Piper,** Staff Engineer, Guided Missile Div., Consolidated Vultee Aircraft Corp.

Industry is constantly striving to make its goods smaller, lighter in weight and stronger. Thus, there is an increasing demand for materials which combine low weight and high strength. A panel composed of experts in several materials fields will tell when, where, why and how each of these materials should be used.

Panel Members:

Low Alloy Steels—**A. F. Stuebing,** Assistant to Manager, High Strength Steel Section, United States Steel Corp.

Light Metals—**Kirby F. Thornton,** Chief Engineer, Development Div., Aluminum Co. of America

Titanium—**George T. Fraser,** Sales Manager, Rem-Cru Titanium, Inc.

Reinforced Plastics and Sandwich Construction—**N. E. Wahl,** Head, Wood & Plastics Section, Cornell Aeronautical Laboratory, Inc.

Molded Plastics—**H. M. Quackenbos,** Development Laboratories, Bakelite Co.

Ceramics and Other Nonmetallics—**Hans Thurnauer,** Vice President in Charge of Research, American Lava Corp.

Question and Discussion Period

Wednesday, June 17

10:00 A.M.

Subject:
Progress in Materials (No. 2)
Materials for High and Low Temperature Service

Chairman: **Dr. H. H. Lester,** Chief, Metals Research Branch, Ordnance Corps., Watertown Arsenal

High speeds and higher operating temperature pose new demands for engineering materials. Too, the need for materials to withstand tough service at sub-zero temperatures creates many new problems. Experts in the fields of materials for extreme temperature service report on the latest developments in those fields.

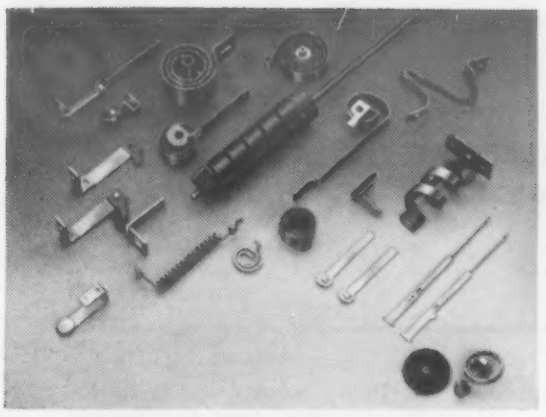
Papers:

"Materials for High Temperature Service"—**H. C. Cross,** Supervising Metallurgist, Battelle Memorial Institute

"Materials for Low Temperature Service"—**Francis B. Foley,** Consulting Metallurgist, Bayonne Research Laboratory, The International Nickel Co., Inc.

Question and Discussion Period

General Plate Products
that solve your Design Problems



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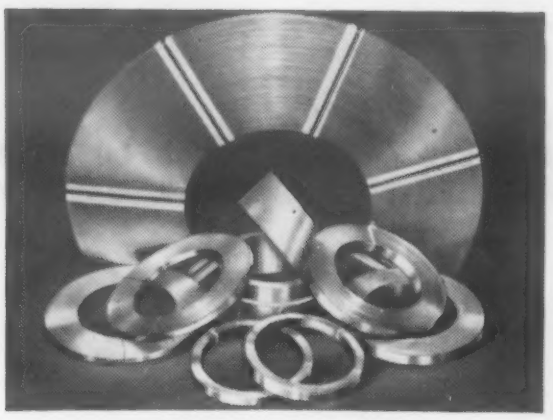
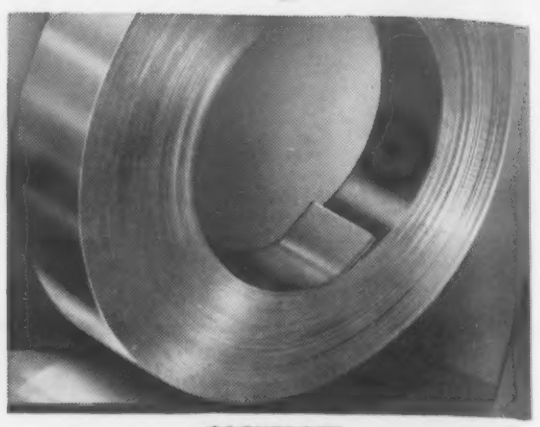
TRUFLEX thermostat metals are manufactured in a wide variety of types, each with a different reaction to temperature. Uniformity of metal insures accurate and consistent performance. Precision parts fabricated to exact specifications.



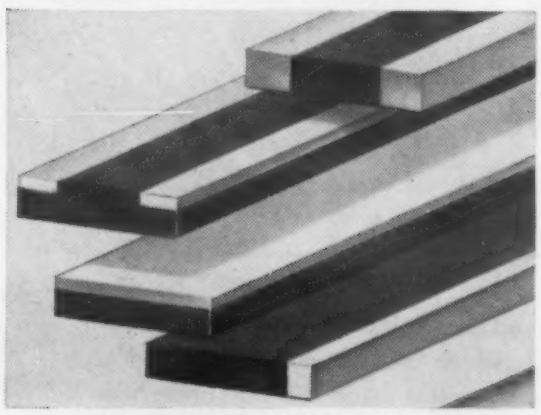
COMPOSITE METALS

Available in practically any combination of precious to precious, precious to base or base to base metals. Combinations for electronics include aluminum-clad iron, nickel-clad iron for anode materials.



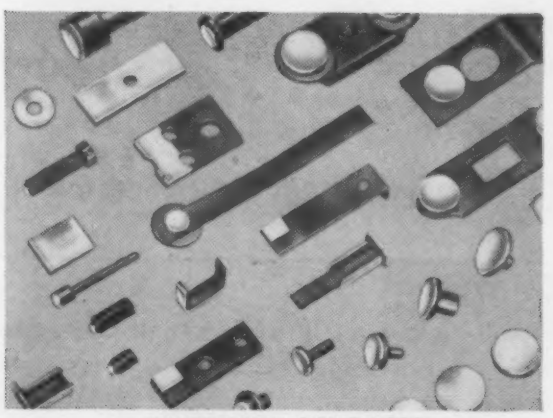
ALCUPLATE

Copper-clad aluminum for component cases or cans, chassis, cooling fins, etc., light weight, excellent conductivity. Copper surface is ideal for soft soldering and electroplating.



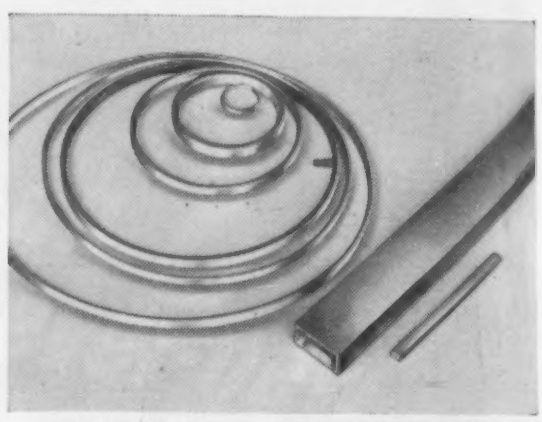
COMPOSITE CONTACT MATERIAL

Precious metals and alloys bonded to base metals available in following types — overlay, single and double edgelay, single and double inlay, Top-Lay, ready for you to fabricate into contacts.



COMPOSITE CONTACTS

General Plate can supply all types of fabricated composite contacts, buttons, rivets, contact assemblies made to customer's specifications. These contacts give electrical conductivity and long life at reduced costs.



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RECTANGULAR WAVE GUIDES. Solid silver, silver lined brass or aluminum. Sizes to government specifications.
COLLECTOR RINGS. Solid silver or precious metal on base metal. All sizes.

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- **Alfer, Alnifer, Nifer** — Aluminum and Nickel-clad steel for anode plates.
- **Alcuplate®** — Copper-clad aluminum for component cases, chassis, cooling fins, condenser blades, etc.
- **Alsiplate®** — Silver-clad aluminum for lightweight condensers, etc.
- **Composite Contacts and Contact Materials**—Increased strength and longer life at reduced cost.
- **Collector Rings** — Fabricated from solid precious metals or precious-clad base metals. Sizes ranging from fraction of an inch to few feet in diameter.
- **Truflex® Thermostat Metal** — Sheet, strip, formed elements and assemblies produced to specification.
- **Thin Gauge Metals** — Beryllium copper, nickel, pure beryllium, Haynes Stellite alloys, etc.
- **Platinum-Group Metals** — Sheet, wire, tubing, parts of all types. Complete assay and refining facilities for platinum-group metals.
- **Silver and Gold Brazing Alloys** — Available as sheet, wire, powder and fabricated parts.
- **Bondwich** — Solder-clad brazing shim for carbide-tipped tools.
- **Bronco** — Phosphor Bronze-clad copper for high conductive springs.
- **Conflex** — Copper-clad spring steel for electrical and thermal conductive springs at low cost.
- **#720 Manganese Age-Hardening Alloy** — Corrosion resistant spring material for diaphragms, springs, finger stock, etc.
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Silver, gold and platinum-group metals bonded on base metals give solid precious metal performance at a fraction of the cost of solid precious metal. The precious metal provides specific performance requirements such as electrical conductivity and corrosion resistance while the base metal provides workability, strength, and solderability.

Composite base metals provide a new group of engineering metals with properties not available in solid metals. Their use frequently results in lower material costs as compared to solid metals.

In many applications further economy results when General Plate supplies fabricated parts ready for assembly into your product. General Plate makes an infinite variety of fabricated parts, such as electrical contacts, collector rings and TRUFLEX thermostat metal parts to customer's exact specifications.

General Plate Engineers will gladly help you with your problems.

You can profit by using General Plate Composite Metals!

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
66 FOREST STREET, ATTLEBORO, MASSACHUSETTS

Wednesday, June 17

Luncheon Session

Subject:
Atomic Energy

Chairman: **J. R. Townsend,** Director of Material and Standards Engineering, Sandia Corp.

Atomic power plants are being predicted within five to ten years. With their coming will also come a new knowledge of materials to contain radio active materials and protect the surroundings from contamination. The luncheon speaker is intimately associated with these problems in carrying on his duties in the Division of Engineering of the U. S. Atomic Energy Commission.

Paper:

"Materials and The Atomic Age"—**J. C. Robinson,** Assistant Director of Engineering, U. S. Atomic Energy Commission, Washington, D. C.

2:30 P.M.

Subject:
Progress in Materials (No. 3) Materials for Electrical and Electronic Service

Chairman: **Alex Javitz,** Associate Editor, *Electrical Manufacturing*

Improvements in electrical and electronic equipment have been a result, largely, of better magnetic materials, better insulation and lubricating materials capable of serving for long periods of time over wide temperature ranges. Current demands ask for even better materials in these groups. The reports to be presented will summarize current materials and discuss probable future developments.

Papers:

"Insulating Materials"—**Dr. A. J. Warner,** Technical Director, Research and Development Laboratories, Federal Telecommunication Laboratories, Inc.

"Magnetic Materials"—**Dr. Eberhard Both,** Materials Section, Components and Materials Branch, Signal Corps, Engineering Laboratories, U. S. Army, Forth Monmouth, N. J.

Question and Discussion Period

Thursday, June 18

10:00 A.M.

Subject:
Materials Specifications and Management

Chairman: **J. B. Seastone,** Manager, Materials Division, Westinghouse Electric Corp.

With the constantly increasing complexity in engineering materials, there is a growing need for most efficient management in materials. Problems of materials management include, among others, the actual selection and specification of the materials and then buying them in their simplest and most economical forms. Experts discuss these two aspects of materials management.

Papers:

"How to Select and Specify Materials"—**J. W. Frazier,** Materials Engineering, Hughes Aircraft Co.

"How Simplification and Standardization Can Reduce Materials Costs"—**Joseph Gurski,** Manufacturing Research Dept., Ford Motor Co.

Question and Discussion Period

2:30 P.M.

Subject:
Materials Utilization-Coordination between Materials, Production, Design and Sales

Chairman: **W. A. Stadtler,** Manager, Technical Services Laboratory, International Business Machines Corp.

Four major forces have a bearing on the selection of any engineering material. Each of the major departments of a company has its own choice, but in most instances the ideal material is one which has the desired properties, is economical and easy to work, and still permits building maximum sales appeal into the product. Experts from various industries tell how cooperation can be developed, regardless of product.

Panel Members:

Theodore Jagen—Senior Engineer, Mechanical Development Group, Hyatt Bearing Div., General Motors Corp.

R. C. Gibbons—Chief Metallurgist, Bendix Aviation Corp., Utica Div.

Question and Discussion Period

Description of Exhibits

Adamas Carbide Corp.
Booth No. 14

Products exhibited include tungsten carbide tools, tool tips, dies and wear parts such as standard and special tools, standard and special preformed blanks, and extrusion dies produced by hot press method. Featured will be a pill press in actual operation and detailed flow charts for manufacture of tungsten carbide.

American Hard Rubber Co.
Booth No. 67

Three new materials recently developed as well as a large variety of hard rubber, rubber-resin blends and thermoplastic materials for chemical, electrical and mechanical applications are exhibited. The new materials are Tempron, a hard rubber compound based on Buna-N; Ace Riviclor, an unplasticized rigid polyvinyl chloride; and Dur-Ace, a thermoplastic, multi-polymer material.

American Lava Corp.
Booth No. 71

Displayed are samples of AlSiMag technical ceramics for wear resistant, elevated temperature and electrical applications. Ceramics with controlled porosity also are shown. Other items exhibited include new metal-ceramic combinations, ceramics with expansion coefficients varying over a wide range, and ceramics that will withstand superheated steam and several hundred pounds pressure.

American Light Alloys, Inc.
Booth No. 78

A display of magnesium and aluminum alloy heat treated sand castings. These castings will be both large and small in size to show intricacies in design and capability of present foundry methods.

American Silver Co., Inc.
Booth No. 73

A wide selection of specialty strip materials—both solid and composite — to illustrate their custom metal processing service now available to industry. The exhibit comprises a multitude of metal specimens, both in coil and in fabricated form. A background is formed by large photo-murals representing some of the company's special plant facilities.

Ampco Metal, Inc.
Booth No. 30

Featured in the display are Ampco's basic alloys, Ampco Metal (aluminum bronze). However, others of the copper-base alloys produced will be shown. These materials will be exhibited in many forms such as sand and centrifugal castings, extruded solid and hollow rods, and simple shapes, pipe, tube, sheet and plate, forgings, as well as arc welding and resistance welding electrodes. Several moving display pieces will offer graphic illustrations of unusual applications of Ampco Metal.

Auburn Manufacturing Co.
Booth No. 6-A

Samples are shown of gaskets, packings, washers, insulators, and other components fabricated from a variety of nonmetallic and metallic materials. Attention is directed to the facilities available for producing these products.

Bakelite Co. **Booth No. 52**

Featured in this exhibit are the vinyl, styrene, polyethylene, phenolic, polystyrene polyester, epoxy, urea, and fluorothene resins and compounds produced by Bakelite. Many of the uses of these plasties are displayed. These uses include surface coatings, sheeting, mats, foils, bonding agents, laminating materials, wire and cable insulation, moldings, extrusions, and many consumer products.

The Beryllium Corp.
Booth No. 3

These basic forms of beryllium are exhibited: (1) beryllium metal and beryllium oxide; (2) beryllium master alloys, including beryllium-copper, beryllium-aluminum and ferro-beryllium; (3) beryllium alloy casting ingots, including beryllium-copper and beryllium-nickel; (4) wrought beryllium-copper products, including billets, rod, bar, strip, wire, redraw tubing stock, plater bar and forgings. Also included are interesting selections of industrial end uses of the various basic beryllium materials.

Brown Co. **Booth No. 53**

Four materials are being shown: Cellate and solka pulps which are used for special papers such as photographic paper. Solka-floc, a fine cellulosic used as filter aid materials and also used as extenders for plastics and welding rod coatings. Nibroc papers used for backing abrasives, gum tape, masking tape, and in plastic laminates. Onco used for insole material and as reinforcing agent in bags, etc.

The Carborundum Co.
Booth No. 20

This exhibit centers around three basic products—aluminum oxide, silicon carbide, and zircon. The relationship is shown between these basic materials and a number of specific products stemming from them, including, for example, Fiberfrax ceramic fiber, zirconium, hafnium, Globar heating elements and resistors, and super refractories.

Cerro de Pasco Corp.
Booth No. 61

Being exhibited are the Cerro alloys (low temperature melting bismuth alloys). The raw components of the alloys are shown, together with the finished products. End products displayed include duplicate patterns,

(Continued on page 158)

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Vibrin's proven ideal for automobile bodies.

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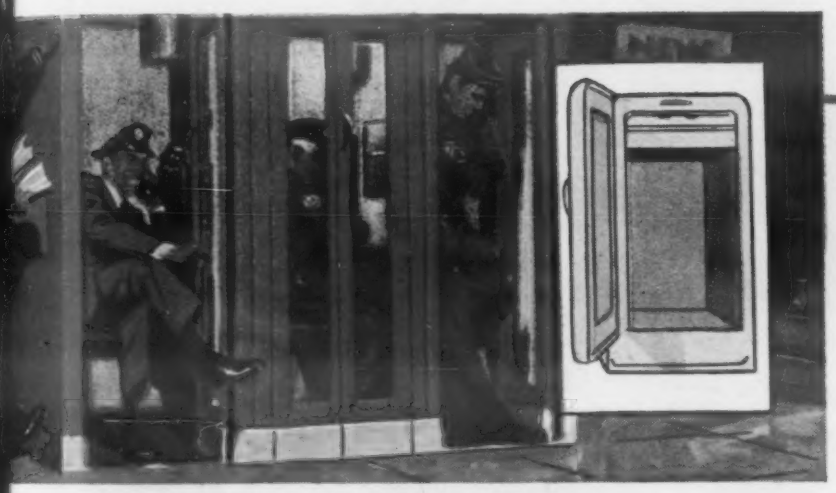

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SICON SILICONE FINISH

CONVENTIONAL FINISH

These two heater shells were subjected by Midland Engineers to a 500°F. heat test, for four hours, followed by a 300 hour salt spray test conforming to ASTM B117-49T. SICON retained color, gloss, adhesion. A widely used specification finish for this purpose failed completely. The pictures tell the story.

ACTUAL TESTS PROVE SICON'S SUPERIORITY

It was felt that army ordnance requirements for truck heaters demanded an olive drab protective finish that would withstand temperatures of approximately 500° F., followed by a salt spray test. SICON was tried and is being used by Stewart-Warner in production because it met these rigorous demands.

If you require a finish in a *decorative color* with specific heat resistant properties, SICON, the original Silicone-Base Heat Resistant Finish, may be the *only* finish that will do the job. It will pay you to investigate. Write for illustrated brochure without obligation.

Manufactured by

MIDLAND INDUSTRIAL FINISHES CO.

WAUKEGAN, ILLINOIS

ENAMEL • SYNTHETICS • LACQUERS • VARNISHES

Exhibits . . .

(continued from page 152)

dies, safety devices, tube and mold bends, electroformed parts, etc., all of which have been fabricated with or by the use of various Cerro Alloys.

Chromalloy Corp. of New York
Booth No. 75

A display demonstrating the effectiveness of the Chromalloy process in producing corrosion resistance, wear resistance, and heat resistance in iron and steel as well as certain applications of the process to nonferrous materials. Examples of heat resistant Chromalloyed parts are shown in operation wherever possible. These include electric strip heaters and tubular heaters with Chromalloyed shells, electric paint burner shields, as well as laboratory ware such as ring stands, burner chimneys and the like.

Continental Diamond Fibre Co.
Booth No. 77

The Continental-Diamond Fibre Co. exhibit displays their standard materials and typical items made of them. Some of these are Teflon sheets and tapes, both supported and unsupported, silicone varnished Fiberglas and silicone rubber Fiberglas, Micabond (bonded mica) insulating material, Dilecto laminated plastics in an extensive line of NEMA grades, Diamond vulcanized fibre, used as an insulator and as a fabricated component and Celoron molded plastic parts.

Corning Glass Works
Booth No. 55-C

A demonstration, by moving exhibits, of the mechanical, thermal, chemical, optical and electrical properties of glass and how these properties can be used by scientists and engineers in all phases of research and industrial activity today.

Dow Corning Corp.
Booth Nos. 12, 13

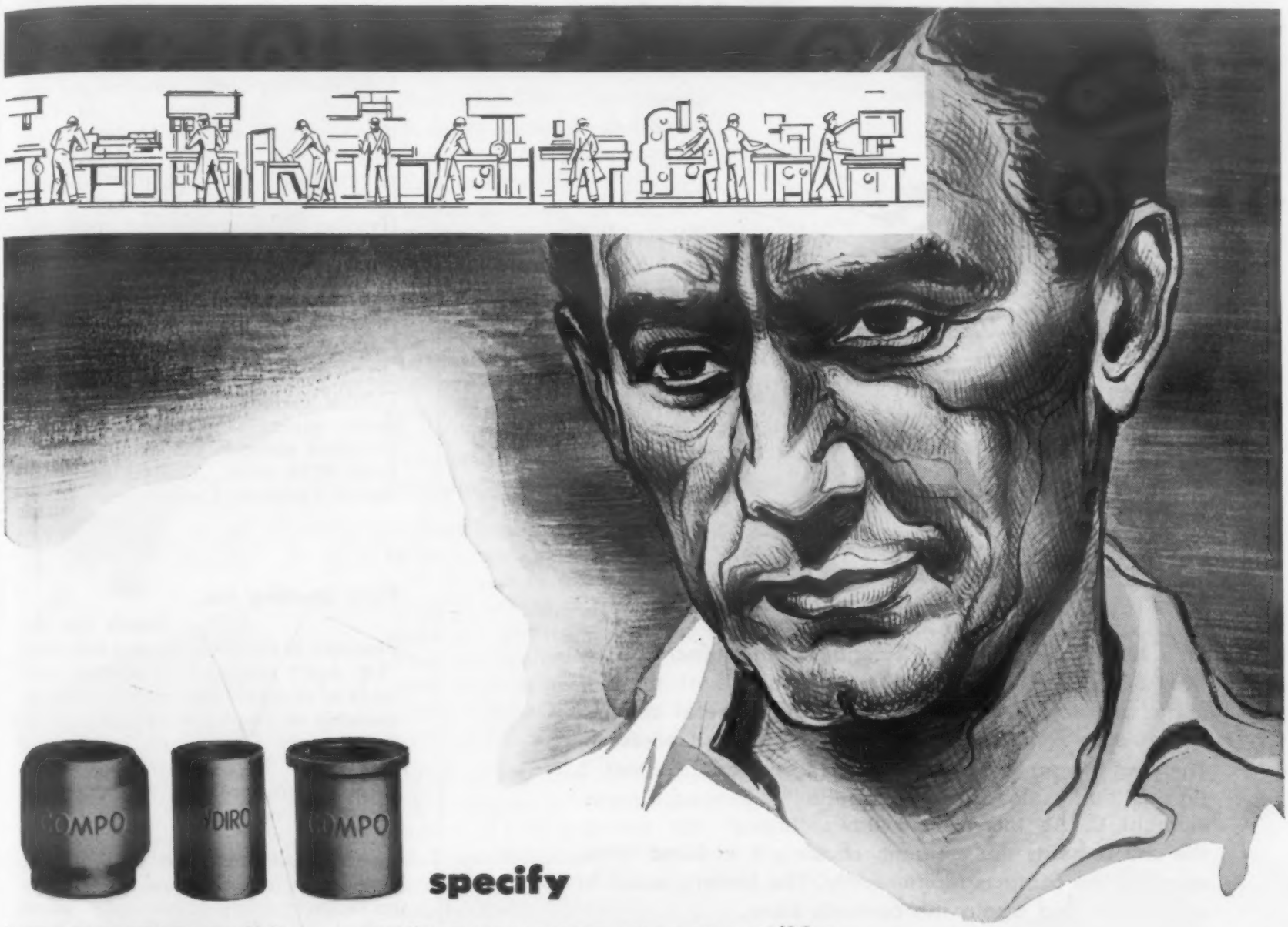
This display provides a comprehensive exposition of the basic properties and typical applications for all silicone products which are produced in all physical forms: fluids and oils, compounds and greases, resins and varnishes, and rubbery solids. Applications demonstrated include Silastic coils for diesels, subminiature electronic parts, and anti-icing flaps for jet engine intake doors.

(Continued on page 160)

"Where'll I get the OPERATORS for 12 reams per unit?"

No wonder your shop squawks, these days, about every job that calls for skilled operators:

What can **you** do about it—**without** sacrificing product quality? Well, you can



specify

"COMPO"® and "POWDIRON"® bearings

(porous bronze) (sintered iron)

They need no reaming! A simple press fit sizes them to accurate as-installed I.D. Most of the time, they do away with the need for oil holes and fittings. That cuts out drilling and tapping operations.

Tell **Production** how these bearings speed up output.

Tell **Management** how they reduce costs.

Tell **Sales** how long they last, with little or no attention.

You'll find all the facts you need on these oil-retaining bearings—products of Bound Brook powder metallury—in our bulletins on advantages, application, installation, sizes. Just write for your copies.

Buy Bound Brook

"COMPO" • "POWDIRON" • "BOUND BROOK"

BOUND BROOK
OIL-LESS BEARING COMPANY

Bound Brook, N. J. **Bound Brook 9-0441**
MANUFACTURERS OF BEARINGS AND PARTS • ESTABLISHED 1883

Stretch your imagination across these startling new developments by **CARBORUNDUM®**

FIBERFRAX® Ceramic Fiber

- *with properties of*

High Insulation
High Dielectric Strength
High Refractoriness
Light Weight
High Capillarity
High Chemical Stability

- *potential uses*

Filter for most acids
Diffuser
Flame arrestor
Furnace insulation
Fireproofing safes
Fire curtains
Filter for hot air and gases
Strengthening electrical insulators
Battery plate separators
Brake linings
Filler for molded plastics
Base for sprayed-on ceramic coatings
Catalyst carrier
Base for electrolytically deposited metallic coatings

ZIRCONIUM AND HAFNIUM METALS *and* ZIRCONIUM COMPOUNDS

- *possible derivatives*

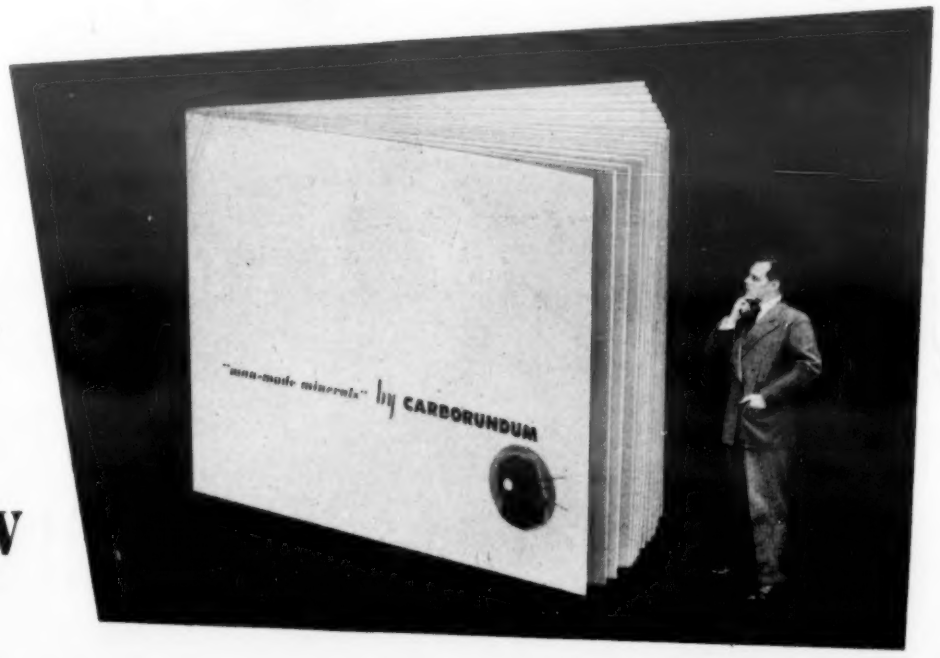
Zirconium Carbonitride
Zirconium Tetrachloride
Zirconium Oxide
Zirconium and Hafnium Sponge
Zirconium and Hafnium Ingots
Stabilized Zirconium Dioxide
Zirconium Sulphate
Zirconium Oxychloride

- *potential uses*

Deoxidizer and desulfurizer for steel and iron
Pyrophoric powder
Alloys for hard facing welding rods
Organo-zirconium compounds like resins
"Fused salts" for refining magnesium
Super refractory materials
Gaseous sponge in high-vacuum equipment
Chemical plant piping and equipment
Structural materials for jet engines and atom engines
Explosives primer
Electronic, radar, television components

● *Stimulate your imagination by seeing our "man-made minerals" at the*

BASIC MATERIALS SHOW



● *Spark your imagination by writing us for this intriguing new booklet!*

CARBORUNDUM

REGISTERED TRADE MARK

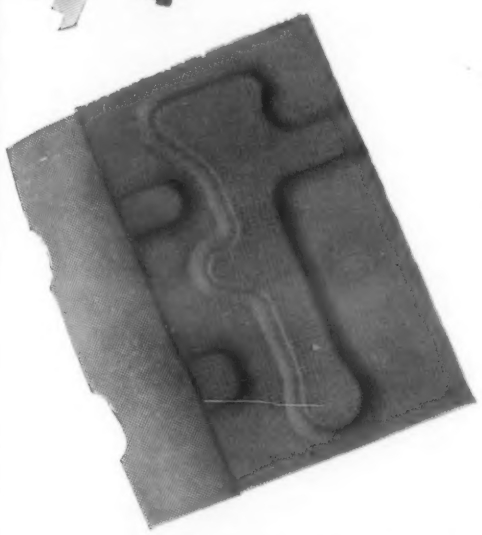
THE CARBORUNDUM COMPANY • NIAGARA FALLS, NEW YORK

Specialists in electric furnace products and processes, coatings, ceramics • Manufacturers of Super Refractories • Electrical Resistors • Electric Heating Elements • Metal Additives • Abrasives

PRINTED IN U. S. A.

EASY . . . INEXPENSIVE TO POST-FORM THESE PARTS WITH

New DILECTO CF-1

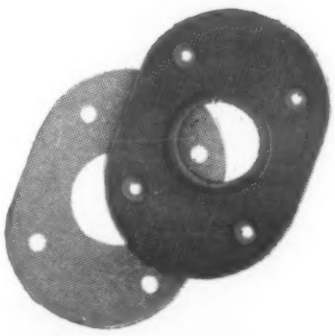


- *Non-After-Glow characteristic*
- *A canvas-based laminate*
- *Post-Forms to shapes in inexpensive cold molds*
- *Excellent mechanical strength*
- *Resists abrasion, has long life*
- *Easily machined and punched*

Where can you use this new canvas-based C-D-F "Post-Forming" Dilecto grade CF-1? Presently it's used for a multitude of aircraft and semi-structural parts . . . as ribbed panels, fan blades and ammunition bay liners, guards and cover frames . . . as ventilating ducts, battery box containers . . . switch covers, thermostat mounting plates, etc. CF-1 has a tremendous potential in electrical as well as other industries because of its strength and light weight.

"Post-Forming" Dilecto CF-1 is easy to work with. Heated until pliable with infra-red, electric ovens, strip heaters or hot plates, or immersed in molten alloys or hot oil, it is then quickly placed in a cold mold and pressed or formed until cold enough to retain the desired shape. Inexpensive molds can be made from hard wood, cast or laminated plastics, steel and metal alloys. Normally C-D-F supplies Dilecto CF-1 in sheets from 1/32" to 1/4" thicknesses.

C-D-F's sales engineers (offices in principal cities) will cooperate with your designers and production experts. C-D-F also forms and fabricates Dilecto to your specifications. Write for technical bulletins describing Dilecto CF-1 as well as other grades of Post-Forming Dilecto.



NON-AFTER-GLOW — Post-Forming Dilecto CF-1 incorporates special chemicals in the varnish that produce no apparent after-glow once an ignited specimen has been extinguished. This product complies with the SAE-Aeronautical Material Specification AMS-3605, latest revision.

SILICONES, TOO — C-D-F offers other post-forming grades of laminated Dilecto: Grade GB-SF is a glass-base Silicone laminate furnished in a semi-cured state for forming pieces where high heat resistance and low dielectric losses are required. Can be formed into armature slot insulators, rectangular coil forms, primary-secondary cylindrical or rectangular insulators for dry type transfomers, etc. Grade XF Dilecto is a paper-base grade for mechanical applications where electrical properties are secondary.

THE NAME TO REMEMBER CDF FOR POST-FORMING DILECTO LAMINATED PLASTICS

Continental-Diamond Fibre Company

NEWARK 25, DELAWARE

ENGINEERS WHO KNOW
FLEXIBLE'S LINE OF TUBING
are solving ducting problems fast

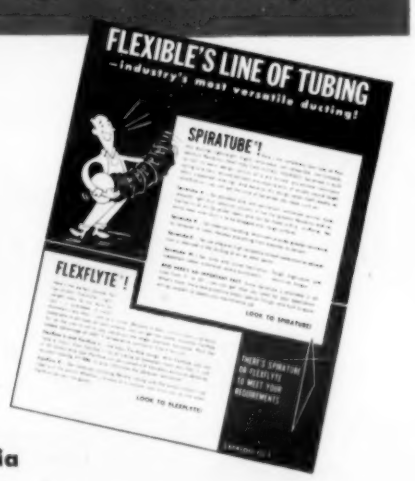
Minimum weight, maximum flexibility and *moderate cost* are just three of the important reasons why so many plant engineers and designers of original equipment are finding Flexible's line of tubing perfect for all ducting requirements. FLEXFLYTE and SPIRATUBE are available in sizes from less than 1 inch to 30" with special fabrics and coatings engineered to special needs. Easily installed, these abrasion resistant tubings permit unobstructed flow of air, dust, fumes and light solids... withstand high temperatures or pressures. Where can *you* use this new-type versatile ducting? Our staff of field engineers are ready to help you with your flexible ducting application. Their experience on hundreds of special applications can save you time and money!

Write today for full details on Flexible's amazing cost-saving ducting!

Flexible Tubing

CORPORATION

Guilford, Connecticut Pasadena 1, California



Exhibits . . .

(continued from page 160)

Gamble Brothers Inc. **Booth No. 29-B**

Featured is a new type of expandable roof. Supporting structure known as Gambella, for portable buildings. Included also is a wide range of composite wood laminates for industrial uses, featuring particularly a new synthetic material which is molded to wood in items where high resistance to chemicals and abrasion is necessary.

General American Transportation Co. **Booth No. 65**

This exhibit is devoted to the new electroless plating method, called the Kanigen process. Parts plated by the process are displayed to show the characteristics and advantages of these metal coatings.

General Ceramics and Steatite Corp. **Booth No. 47**

Displayed are this company's line of high grade technical ceramics and steatite insulators, supplied to the electronic and electrical industry. In addition, a complete line of magnetic ferritic materials, known as Ferramics, are shown. Also of interest are solder seal terminal bushings for the hermetic sealing of transformers, capacitors, relays, delay lines and other electronic apparatus.

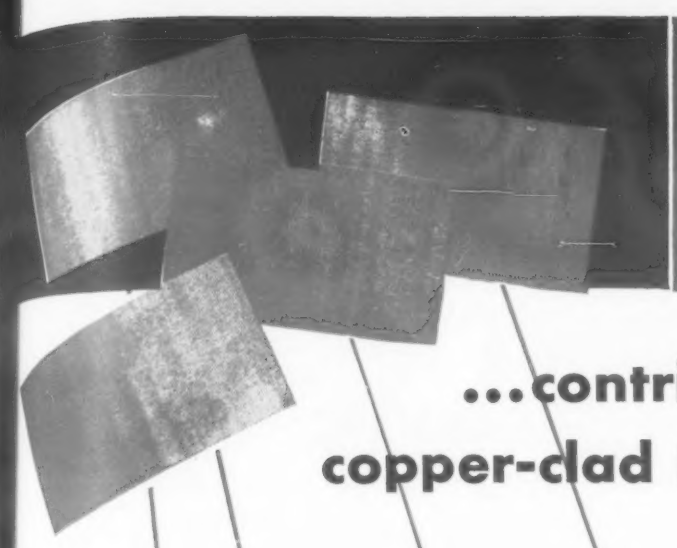
Hanovia Chemical & Manufacturing Co. **Booth No. 6**

A comprehensive display of optical and electronic quality transparent fused quartz, shown in massive blocks and in disks up to 15 in. in dia. Centrifugally cast silica pipe is being shown for the first time. This is a completely new product and has not been previously announced.

Haveg Corp. **Booth No. 77**

The Haveg Corp., which manufactures all types of corrosion resistant equipment for chemical, metallurgical, textile and food products industries, is exhibiting samples of the basic materials from which their products are made as well as many small items made of these materials for the visitors' inspection. A large display of photographs of full scale plant equipment also is shown.

(Continued on page 170)



NATIONAL VULCANIZED FIBRE

...contributes to an improved product— copper-clad Peerless Capacitors for Bendix Radios

These copper-clad Peerless capacitors are used by the Bendix Radio Division, Bendix Aviation Corp., on the voice coil circuit and power input lead of their automobile radios. The capacitor is a combination of Peerless Insulation .004 inch thick copper-clad on both sides with .00135 inch copper foil. Punched clean, Ohmeter tests indicate no shorts between the copper foil surfaces. A minimum capacitance of 200 mmf is obtained.

This practical use of Peerless Insulation, a paper-thin grade of National Vulcanized Fibre, is typical of the countless contributions made by *the material of a million uses*—National Vulcanized Fibre—to business and industry.

National's Peerless Insulation was the *first* fish paper and has been accepted as standard ever since. It is smooth, strong and has excellent forming qualities. Write for detailed literature and engineering service information—

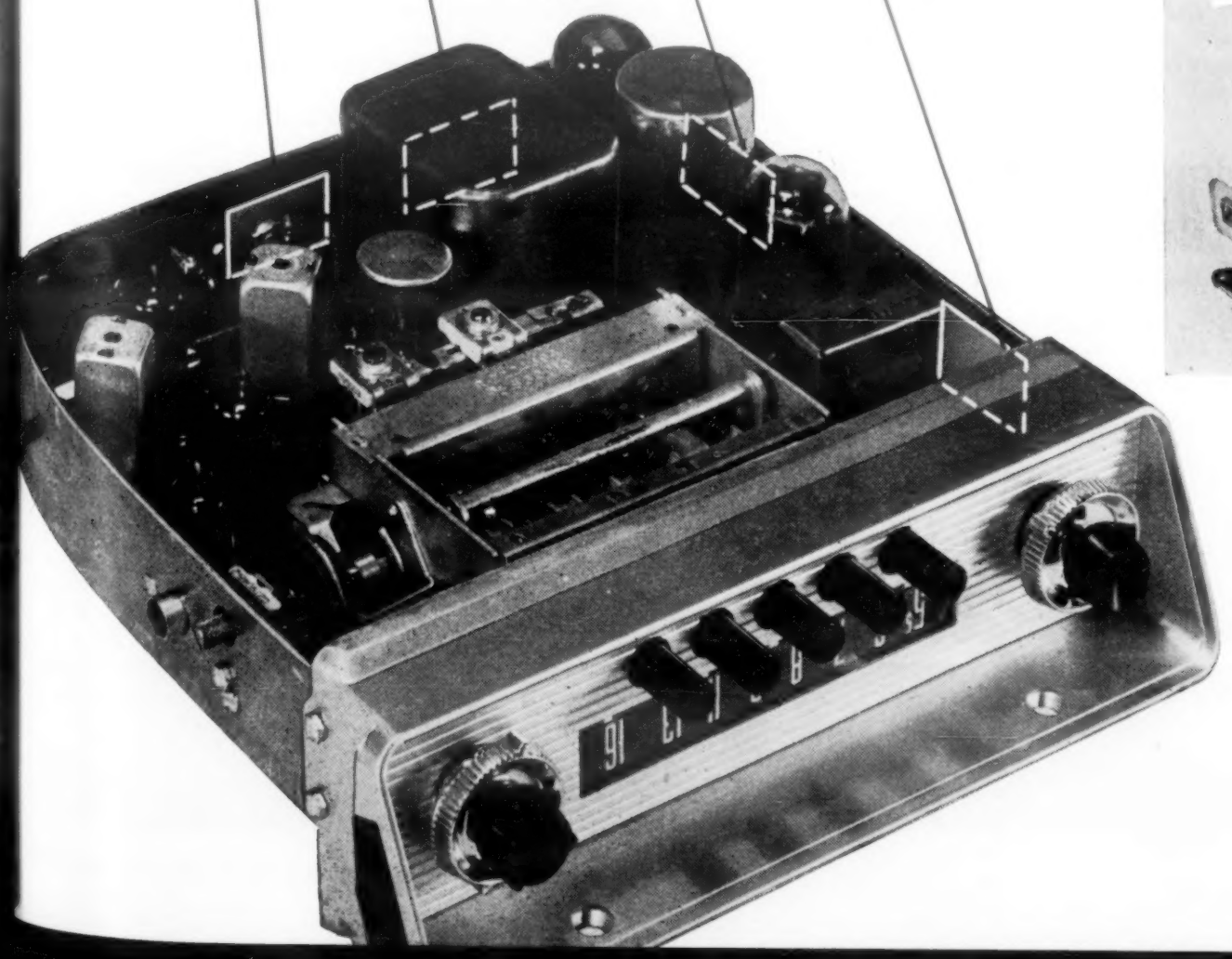
NATIONAL VULCANIZED FIBRE CO.

Wilmington Delaware

Offices in Principal Cities

Since 1873

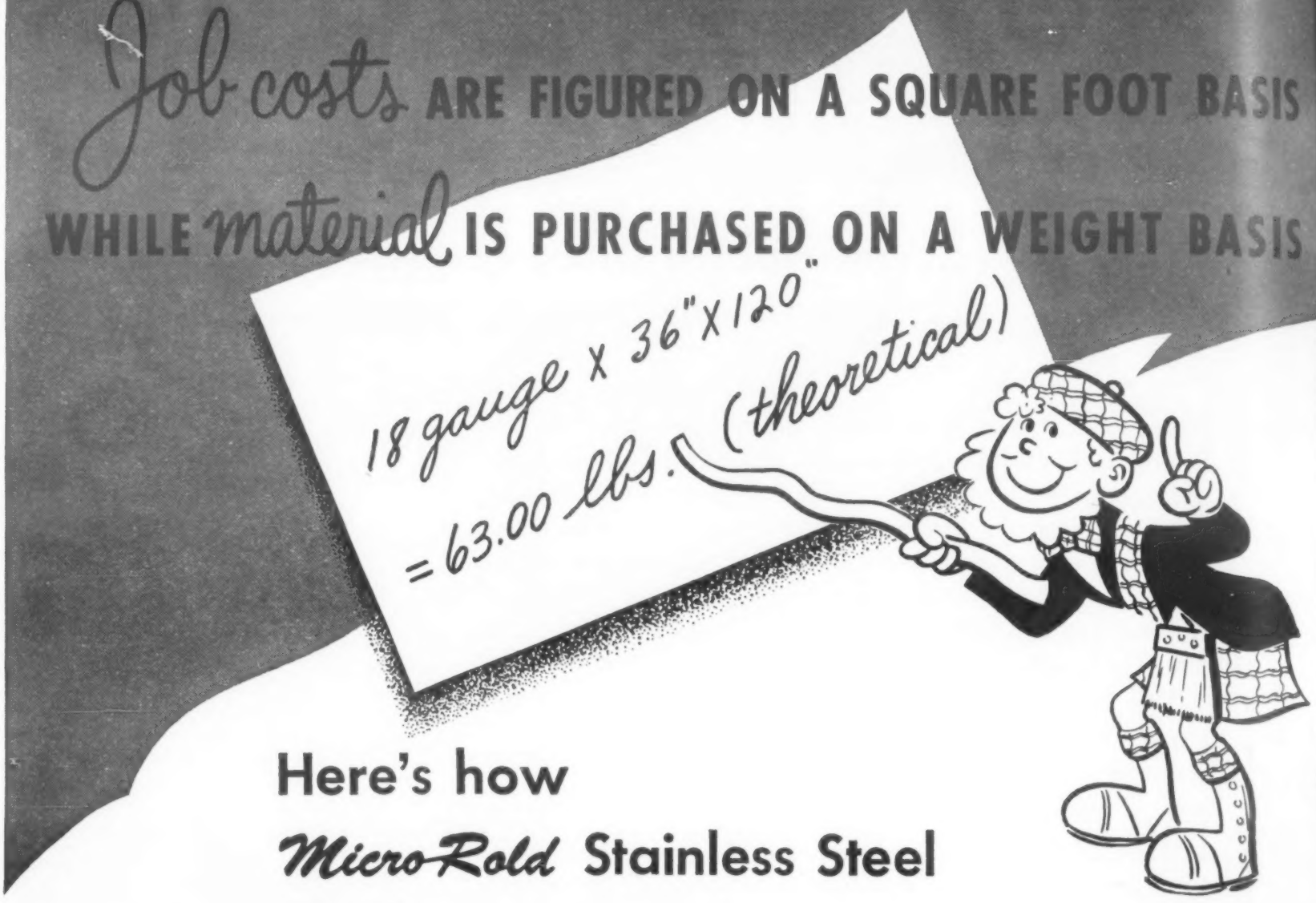
National Laminated Plastics
nationally known—nationally accepted



Peerless Insulation, possessing high dielectric strength plus excellent rigidity, is copper-clad on both sides to make these capacitors. The punched parts, selling for approximately 7/10 of one cent, replace commercial types of capacitors costing five or six cents.

Job costs ARE FIGURED ON A SQUARE FOOT BASIS

WHILE material IS PURCHASED ON A WEIGHT BASIS



Here's how *MicroRold* Stainless Steel SAVES you money

In the use of stainless steel, the selection of gauge number is usually determined by the minimum permissible thickness having sufficient strength to meet the requirements of the application. When you receive material on the heavy side of the gauge you are paying a premium for stainless surface area.

When sheets are ordered by gauge number, the permissible A. I. S. I. variation in thickness is plus or minus 10%. Thus, if you order 18 gauge, you may receive sheets .052" thick, when a thickness of .0475" would suit your purpose. Using a standard 18 gauge 36" x 120" sheet as an example, the theoretical weight is 63.00 pounds, but this weight could permissibly vary between 59.22 pounds and 65.52 pounds. Each .001" of thickness adds 1.26 pounds per sheet.

MicroRold sheets may be ordered by gauge number and you can specify they be rolled on the light side of the gauge range. This is true because the equipment is such that more accurate control of thickness is possible.

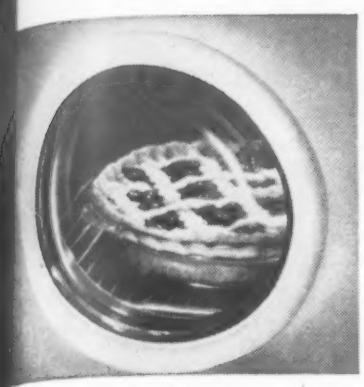
If you are not a user of MicroRold sheet it will pay you to get the full details. Your steel warehouse distributor will gladly tell you the MicroRold story.

Washington Steel

CORPORATION

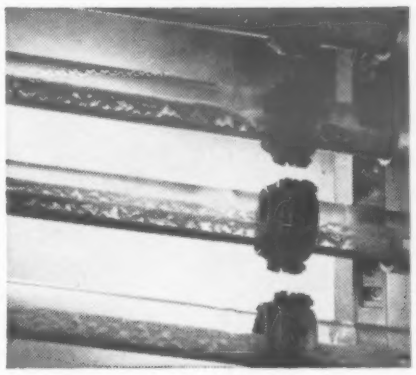
WASHINGTON, PENNSYLVANIA

8 properties of glass to help you make better products



1 Transparency

You can let customers see inside your product through glass. A good example is the PYREX brand oven window that *stays* crystal clear.

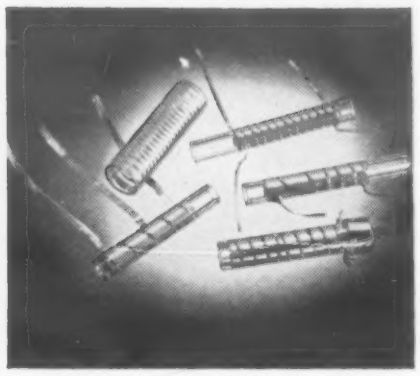


2 Corrosion Resistance

If your product must cope with corrosive liquids or atmospheres, glass will improve its operation, lengthen its life. It's the world's most corrosion-resistant material. The severe service PYREX brand pipe stands in chemical plants illustrates the point.

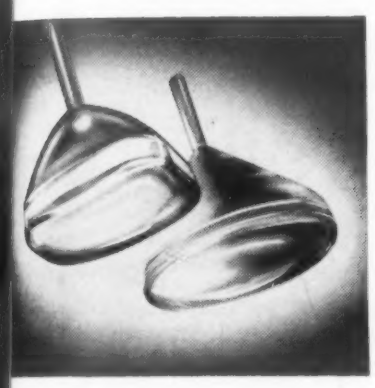
3 Heat Resistant

Don't rule out glass where your problem is heat, or quick switches from hot to cold. PYREX brand glass No. 7740 will stand temperatures from below zero to 250° F., while VYCOR brand glass goes up to 1800° F.



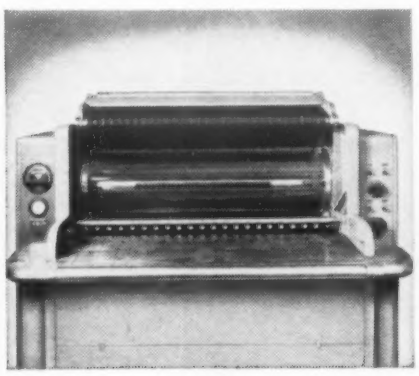
4 Electrical Stability

Glass components may provide such properties as low power factor, low temperature coefficient of capacitance and inductance.



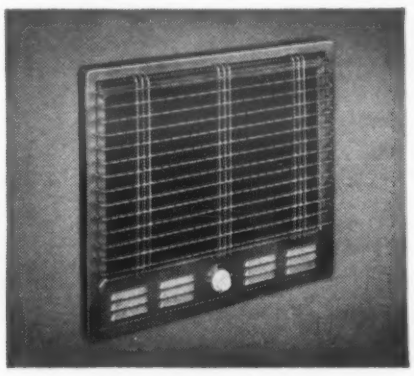
5 Hermetic Enclosure

Glass forms perfect glass-to-glass or glass-to-metal seals for vacuum-tight applications. Vacuum bottles are a good example. So are TV tubes and sealed beam headlights.



6 Light Transmission

Glass can accurately control and transmit light with permanent reliability. Good examples are all around you but one rather unusual one is the glass cylinder in this printing machine. It transmits the ultraviolet rays produced by a mercury arc lamp.



7 Heat Generation

Although you normally think of glass as an electrical insulator, Corning's E-C glass conducts electricity and radiates heat. E-C glass is ideal for space heaters, dryers, and other applications especially where an *even* heat distribution is wanted.

8 Photosensitivity

Designs reproduced photographically in Corning's special photosensitive glass cannot fade or wear off. They are ideal for permanently reproducing nameplates, photographs, artwork and offer a variety of design possibilities.

These eight properties give you only an indication of the versatility of glass by Corning.

This remarkable material can be made extra strong or weak, to conduct electricity or act as an insulator, to pass light or cut it off in virtually any size, shape or color you need.

It may pay you well, in terms of better operating characteristics, lower production costs, and extra sales points for your product, to consult Corning engineers before you reach the blueprint stage. For further information, just mail the coupon or write for a copy of, *"GLASS—its increasing importance in product design."*

CORNING GLASS WORKS
CORNING, NEW YORK

Corning means research in Glass

CORNING GLASS WORKS, Dept. MM-6, Corning, N. Y.

Please send me your 12-page illustrated booklet, "GLASS, its increasing importance in product design."

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

BOOTH 224

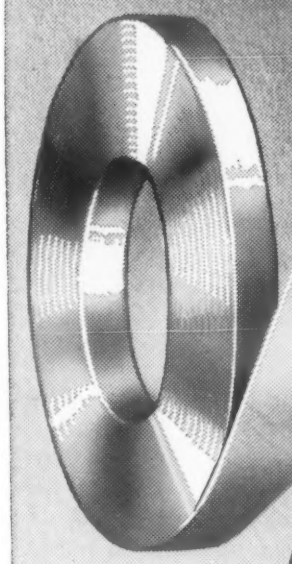
Grand Central Palace
June 15th-19th

EXPOSITION OF BASIC MATERIALS FOR INDUSTRY

COLD ROLLED
PRECISION GAUGE
STRIP
All Tempers
All Finishes

GAUGES:
.0015" to .023"

WIDTHS:
1/2" to 24"



LOW CARBON STEEL
STAINLESS STEEL
ALUMINUM ALLOYS
Other Metals

ALSO PREPAINTED STRIP FOR BLANKING, FORMING AND DEEP DRAWING

RODNEY METALS, INC.

Mill: Rodney French Boulevard • New Bedford, Mass.
Executive Offices: 261 Fifth Avenue • New York 16, N. Y.

See

CARBON STEEL ROLLED TO .001"
as wide as 24"!

STAINLESS STEEL ROLLED TO .002"
as wide as 24"!

PREPAINTED STRIP
that can be Blanked, Formed and Deep Drawn without marring the Finish!

BE SURE TO VISIT RODNEY METALS AT BOOTH 224

Exhibits . . .

(continued from page 166)

Heintz Manufacturing Co.
Booth No. 38

The following general classifications of products are being displayed: jet engine components, automotive stampings, small specialty stampings, automotive grills, brazed household evaporators, gasoline housing assembly, dish washer, clothes dryers, vitreous enameled products, stainless steel beer barrel, stainless chemical container.

Hess, Goldsmith & Co., Inc.
Booth No. 29

This exhibit shows a full range of woven glass fabrics both for industrial and decorative use. Among the many uses demonstrated are glass fabrics for the electrical, aircraft, and plastic reinforcement industries. Other products include glass reinforced papers, films, foils, for the pressure sensitive and gummed paper industries.

Howard Foundry Co.
Booth No. 58

A display of permanent mold castings, sand castings and investment castings. Featured are castings of aluminum, magnesium (including the high strength alloys), brass, bronze, copper, alloy steel, electric alloy stainless steel, gray iron, ductile iron, ferrous and nonferrous investment castings. Also featured is the company's wood and metal pattern shop, the largest in this country.

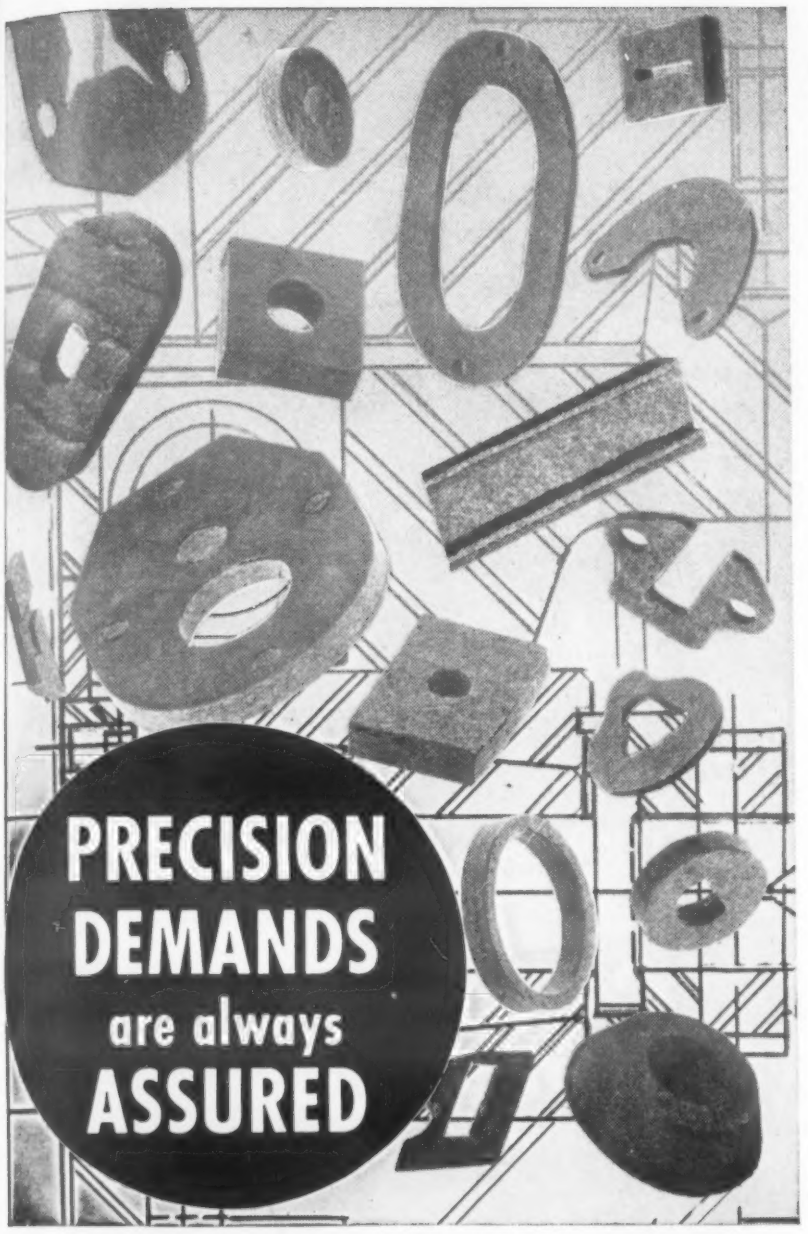
The Improved Seamless Wire Co.
Booth No. 76

A display of this company's line of laminated metals which are available in various forms such as flat stock and tubing. Some of the items exhibited include silver, gold and platinum on the various nonferrous metals and also silver on steel.

Industrial X-Ray, Inc.
Booth No. 27

Industrial X-Ray's display booth is a visual demonstration of the latest developments and techniques in the use of x-rays for industry. Material and information show users and non-users of this type of service how time losses can be avoided and production of all types of manufactured products increased.

(Continued on page 174)



Technique of Western Felt production and processing has built an enviable reputation for engineering precision. Chemical specifications must be perfectly met—parts from wool softness to rock hardness are cut to close tolerances. As an extremely versatile material Western Felts are resilient, flexible, compressible. They resist oil, water, heat, age—do not ravel, fray or lose shape. New uses found daily. It pays to depend on Western Felt.

Check Possible Uses for Your Product

- Excluding dirt, grit, dust • Retaining lubricants
- Thermostatic insulation • Isolating vibration
- Cushioning shock • Padding, packing, seals
- Air and liquid filters • Gaskets, channels, etc.
- Grinding, polishing, etc. • Weight reduction
- Instrument mounts

Sheet and Roll Felt Manufactured for Special Purposes and To Meet All S.A.E. and Military Specifications.

WESTERN Felt WORKS

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Branch Offices in Principal Cities

MANUFACTURERS AND CUTTERS OF WOOL FELTS

have you discovered FORMICA laminated plastics?

It's the toughest, strongest, most durable material you can buy in its weight class. It's half the weight of aluminum. Its strength-weight ratio compares favorably with steel. Meets or exceeds the standards set by N.E.M.A. Productive Formica comes in sheets, tubes, rods and special postformed and molded forms. It can be punched, turned, milled, drilled, threaded and stamped on machinery already in your metal-working or woodworking shop. Productive Formica is noted for increasing sales volume and for lowering manufacturing costs.

It can do as well for you . . . because it's a versatile material of many uses . . . excellent for electrical, chemical or mechanical applications. Why not see for yourself. Send today for colorful new general catalog just off the press.

MAIL THIS COUPON

Productive **FORMICA** Reg U.S. Pat. Off. at Work in Industry

THE FORMICA CO., 4678 Spring Grove Ave., Cincinnati 32, Ohio

GENTLEMEN: Please send me at once and without obligation the new Formica general catalog.

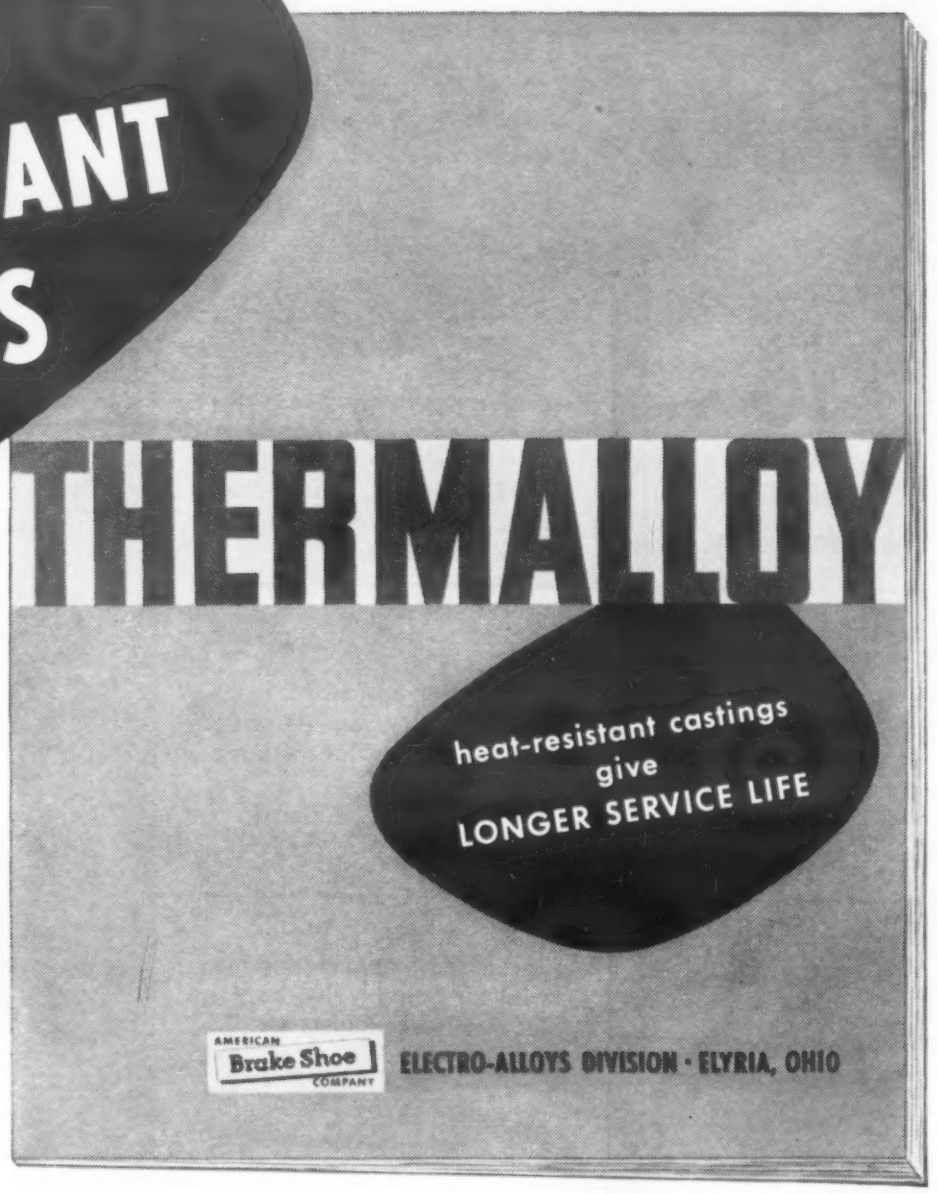
Name_____

Address_____

See you at FORMICA BOOTH 263

Designed for
Lasting Beauty with
REVERE
ALUMINUM
More and more manufacturers of commercial products have turned to Revere Aluminum because of its high strength, workability and lasting beauty. And with Revere Aluminum they are assured of a fine, uniform quality.
Revere meets your requirements with a wide range of aluminum alloys in extruded shapes, coiled sheet, drawn tube, electrical bar and forgings. And for assistance with a specific problem, the Revere Technical Advisory Staff is ready to serve you. For the best in aluminum or technical assistance . . . call Revere.
REVERE
ALUMINUM
REVERE COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities.
SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

here's help
in ordering
HEAT-RESISTANT CASTINGS



NEW BOOKLET
gives complete information about THERMALLOY*

Ordering the *right* heat-resistant castings that give you top performance with the longest service life . . . requires a careful analysis of your problem. At Electro-Alloys, you will find the trained personnel and facilities needed for this service.

This new, 16-page, illustrated booklet will give you the complete story . . . with photographs of modern foundry facilities . . . case histories of Electro-Alloys design and engineering help . . . suggested Thermalloy applications for your industry . . . technical charts that give you detailed performance figures for the various grades of Thermalloy.

For your answers to how Electro-Alloys can help you with Thermalloy heat-resistant castings, write for your free copy today . . . Electro-Alloys Division, 4001 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

AMERICAN
Brake Shoe
COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

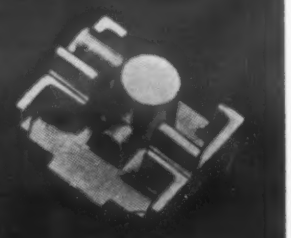
ATLANTALLOY

PLASTER MOLD CASTINGS CAN SOLVE YOUR DESIGN PROBLEMS

Atlantalloy plaster mold precision castings provide non-ferrous castings *cast to ordinary machining tolerances*, effecting definite savings in machining and other costly operations. Atlantalloys are characterized by high strength, durability, and many other advantages.

NO. 10
YELLOW BRASS
Atlantalloy

An all-purpose alloy for brush boxes, gears, levers, etc. Fine grain, clean, smooth surfaces assure tightness. Easily machined. Free from porosity. Fatigue resistant.



NO. 20
ALUMINUM BRONZE
Atlantalloy

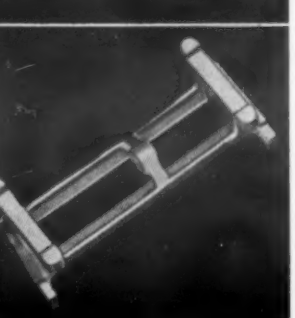
Excellent for gears and bearings. Strong, light, zinc-free. Highly resistant to corrosion. Machines well.

NO. 31
High Tensile
MANGANESE BRONZE
Atlantalloy

High strength engineering material for gears, valve bodies, electrical mechanisms, etc. Extremely durable. No heat treatment needed. Can be cast in thin sections.

NO. 40
High Strength
ALUMINUM
"Tenzalloy"

Attains high strength through natural aging. Free from internal stress and skin hardness. Ideal for machining.



NO. 60
ALUMINUM
Atlantalloy

Perfect as instrument alloy. Fully uniform with no internal strain. Can be used for accurate, thin-sectioned castings.

WRITE..

for free copy of "Quality Precision Castings for Industry." Get full data on our plaster mold process and alloys.

ATLANTIC CASTING and ENGINEERING CORP.

Established 1937

721 Bloomfield Avenue • Clifton, N. J. • PRescott 9-2450

Exhibits . . .

(continued from page 170)

International Balsa Wood Corp.
Booth No. 8

Balsa wood, the lightest commercial wood in the world, and pound for pound, one of the strongest, is being demonstrated here. Shown are its use in a number of app'ications, alone, and in combination with other materials, for the purpose of accomplishing reduction in weight, increase in strength, insulation, isolation against noise and vibration, and others. Displayed are samples of materials used in aircraft construction, refrigeration insulation, marine applications, sporting goods, electronics, etc.

Janney Cylinder Co.
Booth No. 17

Finished machined products made exclusively from centrifugal castings of brasses, bronzes, stainless steels, alloy irons, monel metal and Ni-resist irons are exhibited. The products include diesel engine liners, cylinder sleeves, shaft sleeves for centrifugal pumps, rings, expansion joint tubes, engraving rolls, hydraulic liners, roll covers, separator rings for ball and roller bearings.

M. W. Kellogg Co. Booth No. 56

The largest and most complete exhibit of Kel-F polymer basic materials and finished products ever displayed is being presented. The exhibit has been specially designed to present the latest technical information and to acquaint manufacturers with the increasing scope of application of these unique chemically-inert and heat and corrosion resistant, dielectric materials in the electrical, chemical and mechanical industries. Animated displays demonstrate these unique chemical, electrical and mechanical properties.

Kennametal Inc.
Booth No. 59

This exhibit has three main divisions showing: (1) Kennametal as a wear resistant material; (2) Kennametal as a heat resistant material, the trade name of which is "Kenatanium"; and (3) Kennametal as a cutting tool material. Under each classification are displayed a wide assortment of parts illustrating the fields of application of these materials.

(Continued on page 178)

open door to better service — with C-11 plastics

The door of every new Servel "Automatic Ice-Maker" refrigerator carries three shelves on its inner side. Shining and clean-lined, they accent the interior's up-to-the-minute styling. Molded from BAKELITE C-11 Plastics for toughness, they'll hold bottles, cans and jars of foods used most.

The shelves are molded to sharp detail in one minute between 580 and 660 deg. F. Each weighs only eight ounces. Spraying the under side with gold paint gives them their rich metallic luster. For attachment to the door, they have studs molded with holes that become self-threading when screws are inserted.

BAKELITE C-11 Plastics are acrylonitrile-styrene copolymers that have several features distinct from both acrylic and styrene plastics. One such feature is strength—their tensile and flexural strengths are 45% higher than those of standard polystyrenes. Another is durability—they withstand contact with tea, coffee, citrus peels, soaps, detergents, oils, cosmetics. Their dimensional stability is excellent.

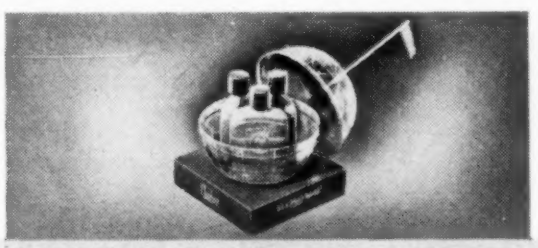
With this combination of properties, BAKELITE C-11 Plastics are extending the usefulness of plastics in such fields as housewares, packaging, product design. For information, write Dept. PX17.

Door shelves for the Servel "Automatic Ice-Maker" Refrigerator molded by Kusan, Inc., Nashville, Tenn.

BAKELITE
TRADE-MARK
C-11 PLASTICS
TRADE MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada:
Bakelite Company (Canada) Ltd., Belleville, Ont.

LASTING COLOR for slide fasteners is achieved with coatings based on VINYLITE Dispersion Resins. They withstand usage, cleaning solutions and boiling soapy water. By Stoner-Mudge, Inc., Pittsburgh 33, Pa. for Crown Fastener Corp.



EYE-CATCHING PACKAGE for men's toiletries is made of transparent VINYLITE Plastic Rigid Sheets, printed and formed into this globe. It's light in weight, strong, and flexible. Made for Charbert, Inc., by Mechtronics, Inc., Mamaroneck, N. Y.

GOLF BALL CONTAINER of BAKELITE Styrene Plastic is combination display package with bottom half usable as practice putting hole, and cover that becomes utility shelf when attached to locker. Molded by Cowan-Boyden Corp., Providence, R. I.

TIN:

Alloy Ally

As a hard-working partner of copper, lead, zinc, nickel, cadmium and other metals, tin is an effectual ally in many an alloy.

Now tin can do still more work for you.

With the end of U.S. Government controls, tin is again freely available—to *any* user, in *any* quantity, for *any* purpose.

And new purposes for this vital metal—new ways in which it can work to make better products at lower costs — are constantly being developed.

Over 1/3 of the world's tin is mined in Malaya. No end is in sight, geologists say, to these important reserves.

So don't let needless concern about future supplies keep you from making profitable use of versatile tin.

Remember, no other metal has all the properties of tin. Tin is inert, nontoxic, friction and corrosion resistant. Tin is highly malleable, second only to gold. Above all, tin is economical to use. A little tin will do a lot of work.

This is the time to investigate thoroughly the ways it can work for you.

This Bureau is sponsored by the tin producers of Malaya to promote better understanding between America, world's largest consumer of tin, and Malaya, world's largest producer. TIN NEWS, issued monthly, will keep you and 8000 other U.S. readers posted on new developments. It's yours, free, if you'll send us your name and address.

Now tin may be purchased by any user—in any quantity—for any purpose.

THE MALAYAN TIN BUREAU **Dept. 681, 1028 Connecticut Ave., Washington 6, D.C.**

RESIST KITCHEN
ACIDS AND ALKALIES

WITHSTAND IMMERSION
IN HOT WATER

EASILY AND
ECONOMICALLY MOLDED

Forgecraft designed to sell with

HERCOCEL®

Duraset handles made from a special high-acetyl formulation of Hercocel A are a feature of Washington Forge's line of kitchen tools. Durable, colorful, attractive, these handles resist kitchen greases, fruit and vegetable acids, and alkaline soaps and detergents. Electronically sealed to the metal sections, they will not loosen. Most important, high-acetyl Hercocel permits repeated immersion in hot water, and safe cleansing in modern home dishwashers. For more information on versatile Hercocel, including a new flame-resistant type, and Hercules design and technical assistance, write:

HERCULES POWDER COMPANY
INCORPORATED
Cellulose Products Department, 966 Market Street, Wilmington 99, Del.

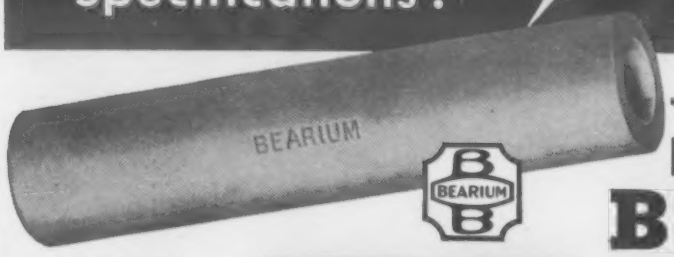
Handles molded for Washington Forge, Inc., Englishtown, New Jersey, by Laurel Plastics Company, Lakewood, New Jersey.

CP53-4

Are You Using Bearing Bronzes in Any of These Specifications?

SAE—660 AMS—4840
SAE— 64 AMS—4842
SAE— 67 AMS—4822
AMS—4825

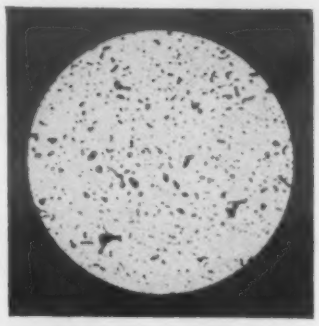
ASTM B-144 ..... Type 3E
ASTM B-144 ..... Type 3A
ASTM B-144 ..... Type 3B



...If you are, it will pay you to consider

BEARIUM METAL instead

FEATURES
NON-SEIZING and NON-SCORING . . . LONG WEARING . . . SELF LUBRICATING . . . LOW COEFFICIENT OF FRICTION . . . HIGH COMPRESSIVE STRENGTH . . . RESISTANT TO SHOCK LOADS . . . SOUND, UNIFORM STRUCTURE . . . FREE-CUTTING.



(Above) BEARIUM METAL magnified 25X shows lead (black) in microscopic, globular form, uniformly distributed.

(Below) ORDINARY LEADED BRONZE at 25X shows poor lead distribution, with lead between copper grains.

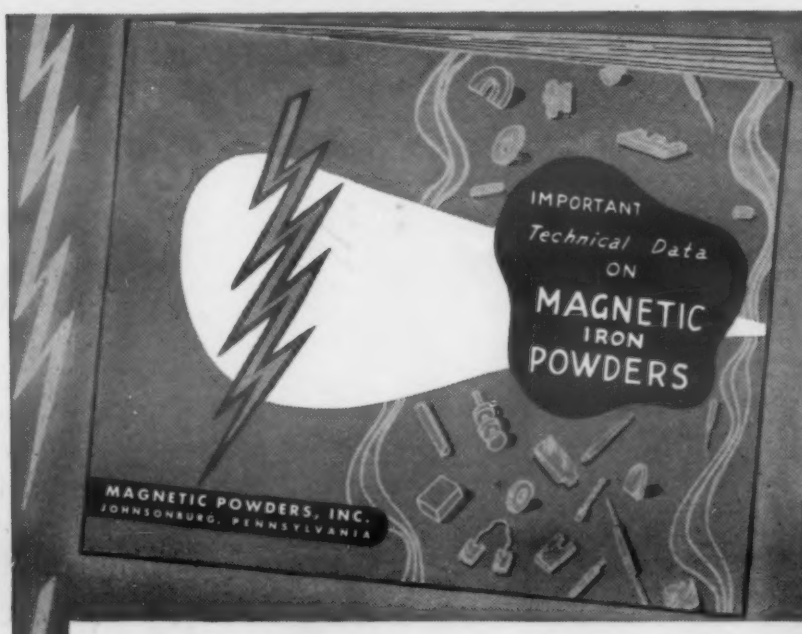
HERE'S WHY—BEARIUM METAL has the physical properties of these bronzes *plus* the frictional properties usually found only in babbitt. Secret of Bearium Metal's Superiority is due to the uniform distribution of microscopic lead particles within the copper-tin grains rather than between the grain boundaries.

Full Information Furnished on Request

BEARIUM METALS CORP.
262 State St., Rochester 14, N. Y.

WEST COAST AFFILIATE:
Nevin Engineering Associates
932 Chatauqua Blvd., Pacific Palisades, Cal.

IN CANADA:
Bearium Metals of Canada, Ltd.
155 George St., Toronto 2, Canada



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CONTAINING IMPORTANT INFORMATION ON
Laboratory Controlled • Quality
RAW MATERIALS
for ELECTRONIC and INDUSTRIAL APPLICATIONS

MAGNETIC POWDERS INC.

Visit us at: MATERIALS SHOW
Booth No. 319

POST OFFICE BOX 247
JOHNSONBURG, PENNA.

Exhibits . . .

(continued from page 174)

Korhumel Steel & Aluminum Co.
Booth No. 18

This exhibit includes colored slides showing this company's warehouse and its service facility machinery, plus a panel board showing samples of steel and aluminum items.

Lepel High Frequency Laboratories, Inc. **Booth No. 1**

On exhibit and in operation is the Lepel 2½-k.w. output electronic tube induction heating unit and the 2-k.w. input spark gap unit together with recirculating water system. Hardening, soldering, brazing, annealing and melting operations are demonstrated with this equipment.

Lignum-Vitae Products Corp.
Booth No. 7-A

This exhibit features actual scenes showing the production of Lignum-Vitae from the time it is brought in from the tropics till it is fabricated into bearings, bushings, rollers, guides, pulleys and hundreds of other self-lubricating items. Of particular interest will be the Ruff and Redi Lignum-Vitae-Segments for marine propeller shaft bearings. A special offer is made during this exhibition to produce without charge samples of any type of bearing and bushing for testing purposes where there may be a potential use for Lignum-Vitae in any form.

Magnetic Powders, Inc.
Booth No. 7

Magnetic Powders, Inc. exhibits parts made by their customers from the various grades of annealed carbonyl iron powders, hydrogen reduced iron powders, and magnetites which they are producing. Descriptive literature and engineering data on these grades of material is available.

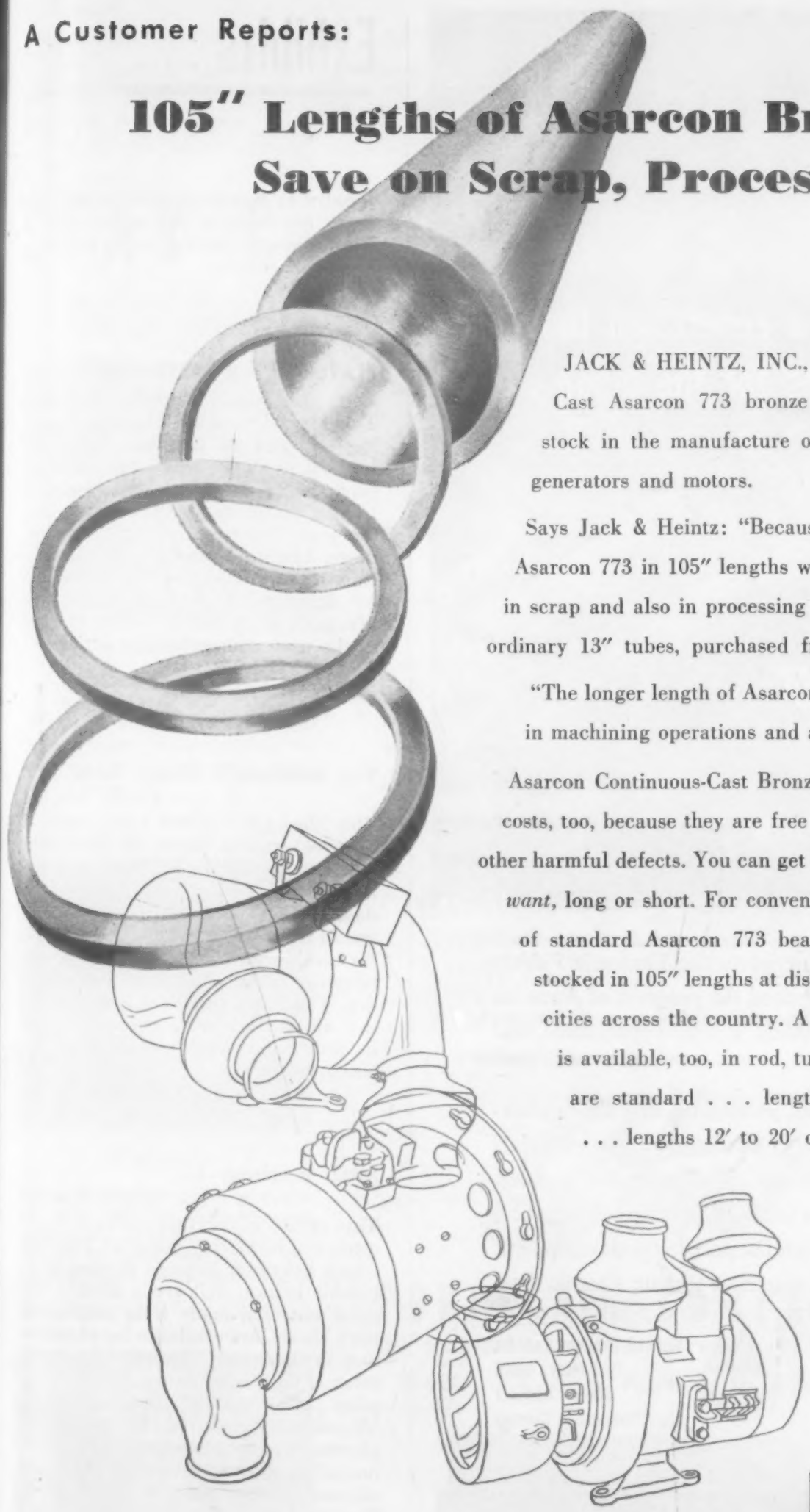
Malayan Tin Bureau
Booth No. 41

The present and future uses of tin are emphasized in this exhibit. Technical information is provided, particularly to those interested in the new tin alloys and chemical compounds, by experts from the Tin Research Institute. Malaya, the vitally important

(Continued on page 184)

A Customer Reports:

105″ Lengths of Asarcon Bronze Save on Scrap, Processing Time



JACK & HEINTZ, INC., Cleveland, buys Continuous-Cast Asarcon 773 bronze tubing (SAE 660) as basic stock in the manufacture of parts for aircraft generators and motors.

Says Jack & Heintz: "Because we are able to get Asarcon 773 in 105″ lengths we effect considerable economy in scrap and also in processing time. We formerly used ordinary 13″ tubes, purchased from a local foundry.

"The longer length of Asarcon bronze saves a lot of handling in machining operations and also cuts down scrap losses."

Asarcon Continuous-Cast Bronzes can reduce your production costs, too, because they are free of all dirt, sand, porosity and other harmful defects. You can get them *in the length you want,* long or short. For convenience, 216 sizes and shapes of standard Asarcon 773 bearing bronzes (SAE 660) are stocked in 105″ lengths at distributors' warehouses in principal cities across the country. A wide variety of other alloys is available, too, in rod, tubing and shapes . . . 12′ lengths are standard . . . lengths 5′ to 12′ on request . . . lengths 12′ to 20′ on special order.

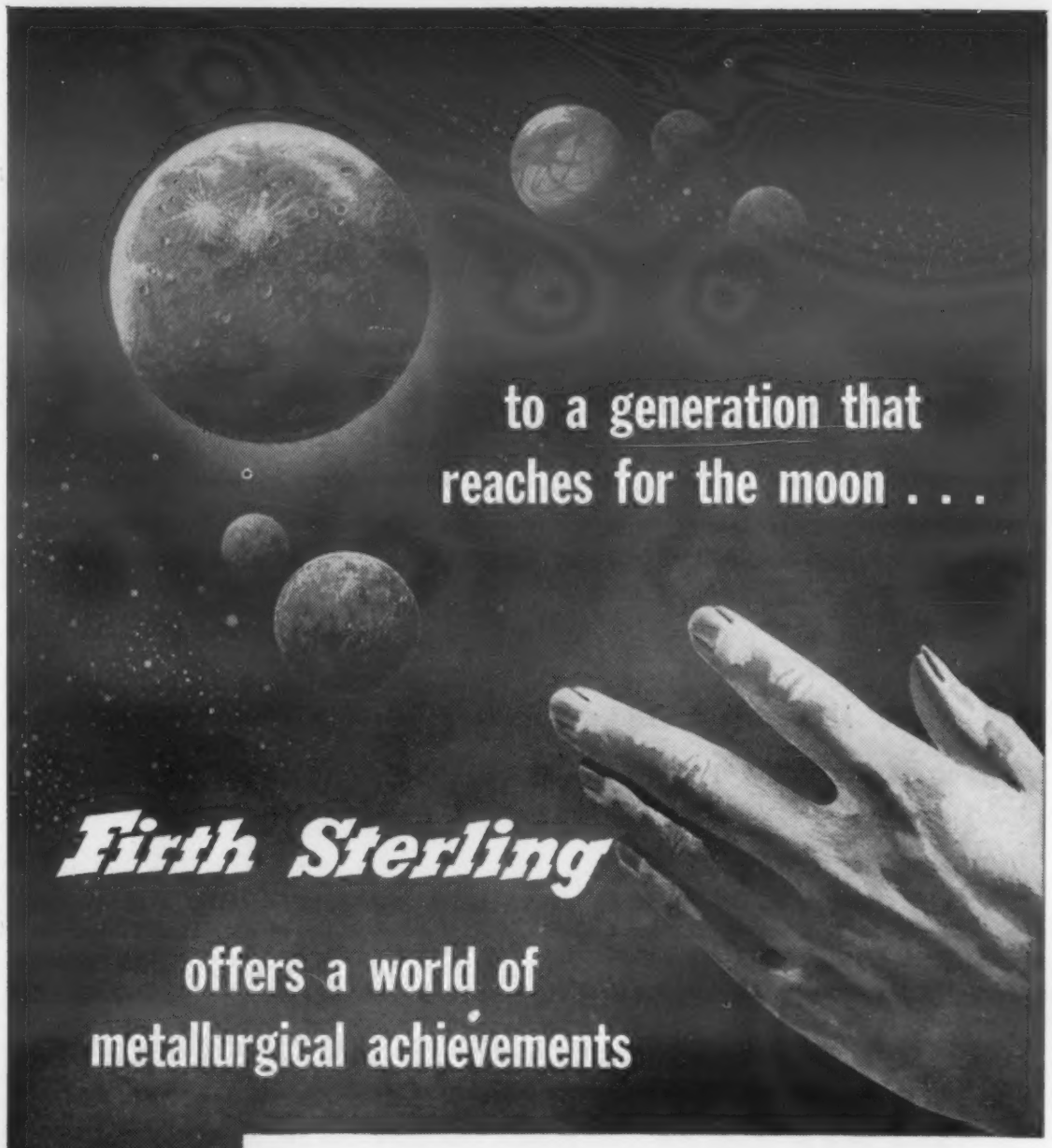
ASARCO
CONTINUOUS-CAST
RODS · TUBES · SHAPES
®

American Smelting and Refining Company

OFFICES: Perth Amboy Plant, Barber, New Jersey • Whiting, Indiana

West Coast Sales Agent:

KINGWELL BROS. LTD., 457 Minna Street, San Francisco, California


to a generation that
reaches for the moon . . .
Firth Sterling
offers a world of
metallurgical achievements
From the Gay Nineties to the Fantastic Fifties, Firth Sterling has paced the progress of America with tool and die steels, stainless specialties, and sintered carbides.
Today, gas turbines, jet engines, and the application of atomic energy all demand new materials to meet new conditions. With expanded research facilities, added to years of practical experience, Firth Sterling still sets the pace in the development of new and better materials for the Atomic Age.
High Speed Steels
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Sintered Tungsten Carbides
Firth Heavy Metal
Chrome Carbides
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Firth Sterling
INC.
Formerly Firth Sterling Steel and Carbide Corporation
GENERAL OFFICES: 3113 FORBES ST., PITTSBURGH 30, PA.

Exhibits . . .

(continued from page 178)

country in Southeast Asia which produces one-third of the world's tin, is featured in the exhibit as the principal source of supply.

MATERIALS & METHODS

Booth No. 55-A

The Magazine of Materials Engineering—devoted to the materials problems of product design and manufacture. Being exhibited are samples of impact extrusions, cold welding, and the lesser known metals such as hafnium, tantalum, zirconium, titanium, tungsten, etc. These exhibits are shown to demonstrate how MATERIALS & METHODS has published either the first or the most comprehensive articles on these subjects.

The Meehanite Metal Corp.

Booth No. 51

The Meehanite Metal Corp. and 11 licensee manufacturers of Meehanite castings are displaying their castings now being used in many varied industries. The cooperative booth is designed to afford individualized sections for the exhibit of castings and interesting information from each foundry. The latest technical literature on the application of Meehanite Metal in industry is also available at the booth.

Mica Insulator Co.

Booth No. 68

This exhibit covers this company's new electrical insulating material, Isomica, which has never been on display in an exhibit before. All types of this Isomica material, made from continuous mica sheets, are available for examination in the booth. Included in minor roles is fabricated raw mica; built-up mica plate using mica splittings, Micanite; laminated thermosetting plastics, Lamicoid; varnished fabrics, including silicone varnished glass and silicone rubber coated fiber glass, Empire line.

Micro Metallic Corp.

Booth No. 74

The following items are displayed: Porous stainless steel sheet, 18 by 48 in. for filtration applications; various shapes fabricated of porous stainless

(Continued on page 188)

In Booth 328—Basic Material Show

STAR Custom Porcelain Specialties

for applications requiring

Resistance to

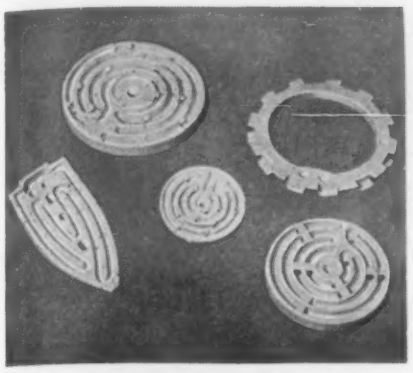
- ELECTRICITY
- HIGH TEMPERATURES
- THERMAL SHOCK
- MOISTURE
- CHEMICALS or
- WEATHERING AGENTS

For complete information—design help, engineering data with electrical and mechanical properties, production facilities and availability—write direct to

Star PORCELAIN COMPANY

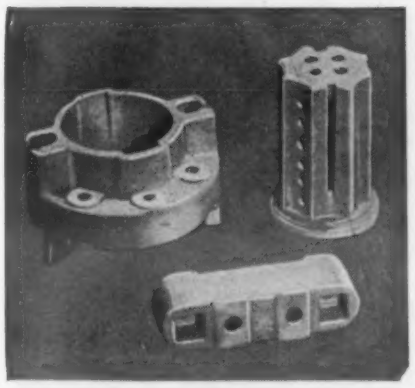
39 Muirhead Avenue • Trenton 9, N. J.

Makers of Electrical Porcelain Since 1899



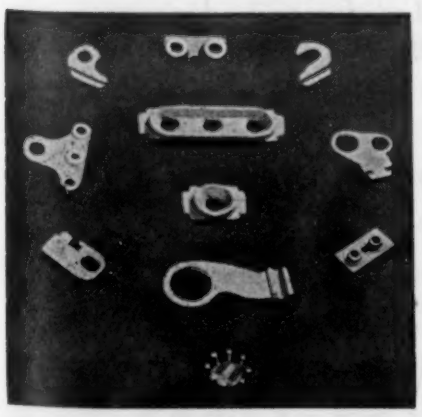
THERMOLAIN

A high grade refractory porcelain with excellent mechanical strength and heat shock resistance. For electric ranges, broilers, air heaters, rheostats, radiants, immersion heaters and furnaces.



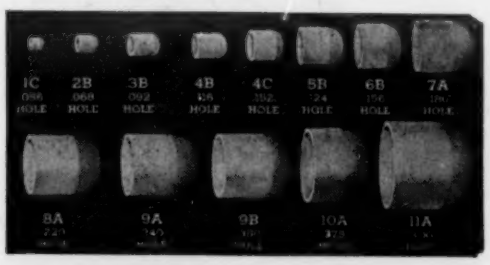
VITROLAIN

Strong, dense, low porosity porcelain with superior dielectric and mechanical strength. Especially adapted to radio, telephone, railroad signal and similar applications.



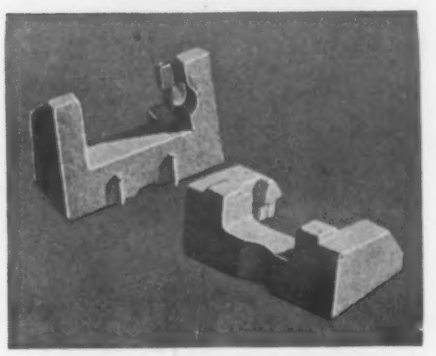
LAVOLAIN

Steatite—strong, dense, heat resistant insulation with exceptional mechanical strength and thermal shock resistance. Excellent for small parts; widely used in heating devices.



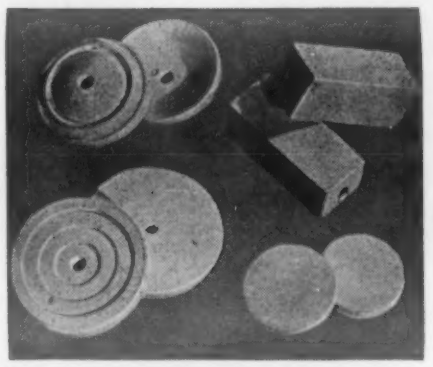
STAR INSULATING BEADS

Ball and socket type for insulating bare wire. Heat resistant . . . high dielectric strength . . . low cost . . . quickly applied. 13 stock sizes. Shown here approximately half actual size. Send for samples.



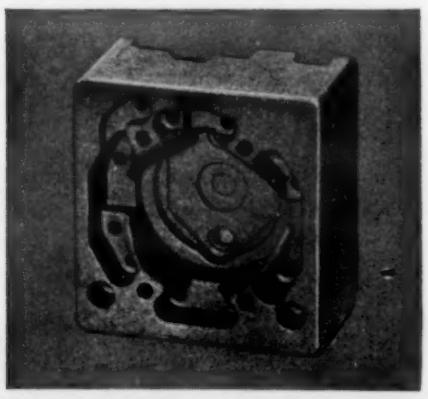
No. 921 INSULATION

Hard stoneware type ceramic with outstanding thermal and electrical properties. Recommended for molding difficult shapes that must withstand severe mechanical strain or heat shock.



HUMIDOLAIN

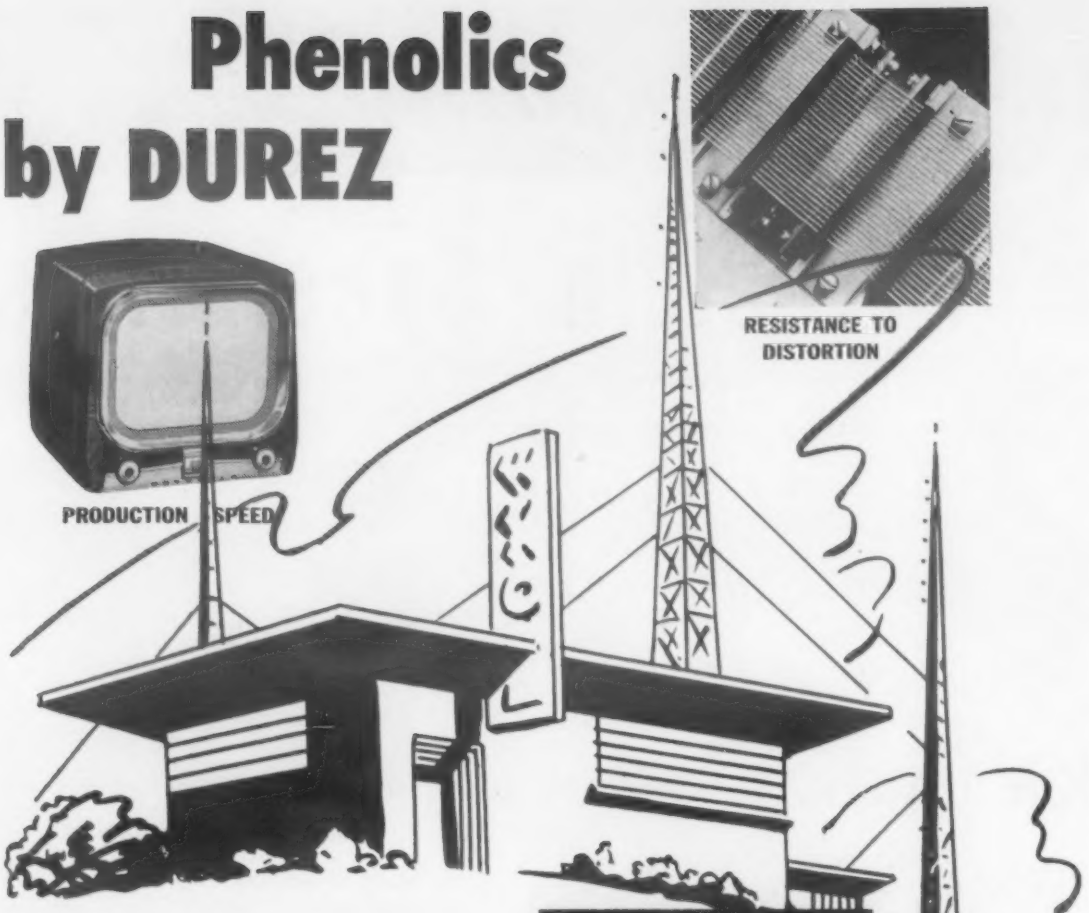
Highly porous, special clay body. Widely used in the manufacture of deodorizers, humidifiers, air conditioning equipment and other applications involving the gradual release of evaporation of absorbed liquids and perfumes.



NU BLAC

Same good dielectric and mechanical strength offered by STAR Commercial White with added advantage of non-soiling in assembly. Used for many types of wiring devices and is adaptable to practically all molded electrical insulator shapes.

Phenolics by DUREZ



for expressing better product ideas BETTER

IMPACT STRENGTH

● When you are thinking of materials for use in new or improved products . . . or processes . . . at the least cost consistent with required performance, remember the way of electricity with Durez phenolic plastics. They get along fine together, but they never mix.

Hence their extensive use in communications equipment. Electrical current goes about its business while these non-conductive plastics go about *their* business of resisting impact and other mechanical stresses, water, heat, abrasion, and many chemicals.

Phenolics can serve you profitably in the form of resins applied to a product or an integral part of it, and as base materials molded into lustrous-surfaced parts. Molded units range in size up to the capacity of the largest presses yet made. Many molding compounds are offered with combinations of properties unavailable in any plastic materials until they were developed by Durez.

Your engineers and molding men can obtain competent help in advancing your product plans from Durez—America's largest producer of phenolics exclusively. Our 32 years of specialized experience is yours for the asking.

ELECTRICAL VALUES

DUREZ
MOLDING COMPOUNDS
PHENOLIC RESINS
INDUSTRIAL RESINS
PROTECTIVE COATING RESINS
Our monthly "Durez Plastics News" will keep you informed on industry's uses of Durez. Write, on office letterhead.
DUREZ PLASTICS & CHEMICALS, INC.
1406 Walck Road, North Tonawanda, N. Y.

Member S. P. I. Committee on Large Plastics Moldings

PHENOLIC PLASTICS THAT FIT THE JOB

Exhibits . . .

(continued from page 184)

steel; hi-strength, smooth surface, aircraft quality porous stainless steel sheet and formed sections for de-icing aircraft wings; porous plastic filtration media in Kel-F, Teflon, rigid polyvinyl chloride and styrene.

Motors and Metals Inc.
Booth No. 10

Exhibited are standard shapes of Monex metals, including rounds, flats, squares, channels, Ts, gear blanks, tubes; surface plates, lapping plates, universal angles, box parallels, straight edges as well as blanks for all precision tools. Also boiler doors, incinerator doors, grate boxes, manhole covers and other drainage equipment.

Mt. Vernon-Woodberry Mills, Inc.
Booth No. 43

Included in this exhibit are: conveyor belt ducks made of combinations of natural and synthetic fibers as well as synthetic fibers alone; Woodberry 887 patented dryer felt; filter fabrics of unusual variety for filtering processes; fabrics for laminating, engineered for special end uses.

Mullins Manufacturing Corp.
Booth No. 59-A

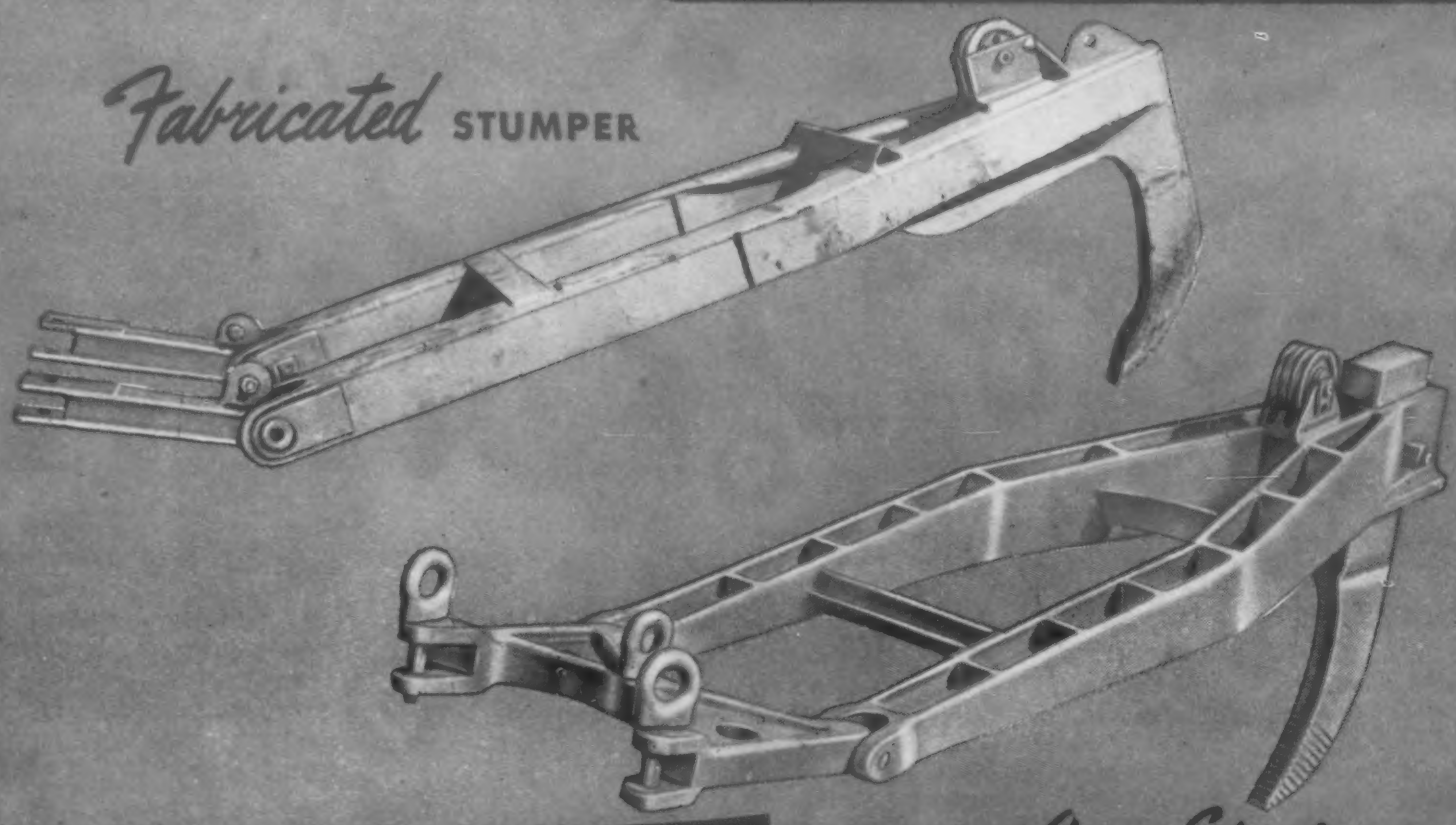
Mullins Manufacturing Corp. is displaying samples of products made by its steel Koldflo process. Application of the process to three specific products illustrate the advantages of Koldflo over conventional methods of forming steel. Other examples of Koldflo products include pieces weighing from one to 45 lb and wide variety of shapes. In each case, the steel slug, a half-section and a completed piece is shown.

Mycalex Corp. of America
Booth No. 11

Main part of the exhibit consists of two modular shadow box units. One contains Mycalex glass-bonded mica sheet, rods and tubes made from machinable grades of Mycalex. The other shows miscellaneous molded and machined Mycalex glass-bonded mica parts. A special display case houses sample components of Mycalex glass-bonded mica, including components with molded-in inserts.

(Continued on page 192)

PRODUCT DESIGN STUDIES • NO. 48



Cost Reduced 20%
Greater Dependability
Better Appearance
with STEEL CASTINGS

When fabricated—from 39 pieces of steel—this tractor-mounted stumper, weighing more than a ton, lacked the dependability required for its tough job. Furthermore it was too costly. To overcome the service deficiencies would have made the cost even higher.

Conversion to a *foundry engineered* cast steel unit—made up of three separate steel castings—not only produced a tool having the necessary strength and durability, but also reduced the cost approximately 20%. Improved appearance was an additional benefit gained through the use of steel castings.

* * *

Here is another example of the foundry cooperation which is resulting in lower costs and improved products through redesign to steel castings.

This service is offered without cost or obligation. It makes available through your foundry representative the full results of the development and research program carried on by the Steel Founders' Society of America.

51 YEARS OF SERVICE TO INDUSTRY

STEEL FOUNDERS' SOCIETY OF AMERICA
920 Midland Building Cleveland 15, Ohio

Design and Build With Steel Castings

How Beryllium Copper Springs keep foods fresher...longer

A BERYLLIUM COPPER SPRING is the "memory cell" of the defrosting mechanism of a leading household refrigerator. This small flat spring completely eliminates the necessity for remembering to defrost at the proper intervals. Thus, this beryllium copper spring functions in the defrosting timing cycle of the refrigerator — and through this increased efficiency, it helps keep foods fresher . . . longer.

The design engineers set rigid specifications for this defroster-actuating spring. They wanted, above all, maximum dependability and long life. The production department insisted on early and frequent deliveries after design details had been settled . . . and they wanted them in large quantities. And, naturally, the purchasing office demanded lower unit costs!

There's nothing too exceptional about these specifications. But there *is*, we believe, an unusual story in the manner in which they were exceeded—*on every count!*

I-S Micro-Processed Springs of Beryllium Copper

were chosen and are still being used for this installation because of their 4-way superiority:

You have the identical basic problems—time and unit costs, plus product performance. We feel that this particular spring application, clearly demonstrates two important Instrument Specialty features: *(1) our ability to produce a better spring, faster and usually at lower cost to you. (2) the specialized ability of our engineers to cooperate with your designers in meeting practically any exceptional problem that involves spring-making.*

It cost you nothing to compare methods and costs.

(*1*) HIGHER DEGREE OF UNIFORMITY AND dependability than conventionally-made springs.

(*2*) I-S DESIGN ENGINEERS' SPECIALIZED experience in spring-making, aided in redesigning for our exclusive "strip spring" technique which permits hardening in multiple fixtures to assure the uniform dimensional and elastic performance. This also resulted in substantial unit-cost reduction.

(*3*) THIS SAME I-S EXCLUSIVE STRIP DESIGN showed further savings in subsequent assembly-line operations—such as cleaning, inspection and attaching of the silver contacts and elimination of costly hand adjustments.

(*4*) ONLY I-S EXCLUSIVE TECHNIQUES, methods and patented equipment could have produced these far superior springs within the time limits set by the production department.

Instrument Specialties Co. Inc.
22 BERGEN BOULEVARD, LITTLE FALLS, NEW JERSEY
Telephone Little Falls 4-0280

For full information on I-S Micro-processed Springs, write today for your free copy of Catalog 7; for Electronic Components, ask for Catalog No. 7-A.

Exhibits . . .

(continued from page 188)

National Vulcanized Fibre Co.
Booth No. 31, 32

National Vulcanized Fibre Co. is displaying various parts fabricated from vulcanized fibre and phenolic melamine and silicone laminates that enter into almost every field of industry. Also shown diagrammatically are the manufacturing processes.

Norton Co. **Booth No. 46**

Products on display include the following standard and experimental materials: Standard materials—Norton fused stabilized zirconia, Norbide (Norton boron carbide), magnesia, and thorium oxide. Experimental materials—zirconium carbide, titanium carbide, titanium diboride, zirconium diboride, boron nitride, titanium dioxide, mixed borides, spinel, mullite, dolomite and lime.

Owens-Corning Fiberglas Corp.
Booth No. 50

Exhibited are a number of representative products and parts made of Fiberglas reinforced plastics.

Plymouth Industrial Products, Inc.
Booth No. 63

Following are some of the items made of industrial thermoplastics—Clevelon, Bartalon and Bestphalt—that are displayed: underground conduit spacers (25 sizes), telephone and farm fence insulators, TV tube supports, decorative home planters, flower pots and jardinieres, packaging devices, toy wheels, skirt marker bases, lamp base inserts, toys and novelties, picture frames, automobile door sill supports.

The Polymer Corp.
Booth No. 33

Polymer Corp. is displaying all of their Polypenco synthetic industrial materials. There is a separate display on nylon products showing the different characteristics of the material, as well as some of the fabricated parts which have been manufactured from stock shapes. Another display for Teflon gives an example of the physical properties and the outstanding characteristics of this material. Also shown are finished parts that have been made either by machining, blanking or other methods of fabrication.

(Continued on page 196)

Industry's Widest Range

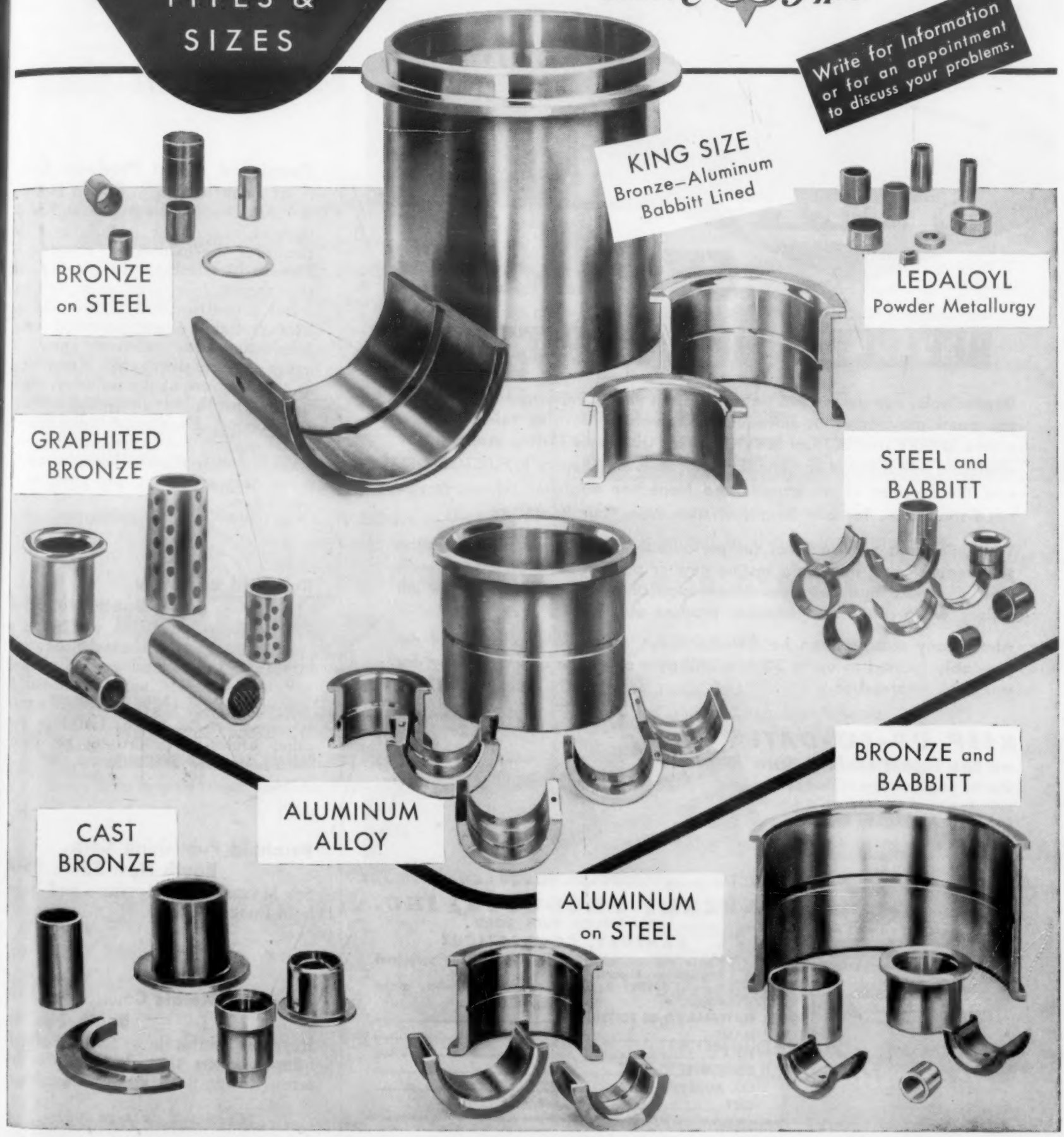
•• OF SLEEVE BEARING TYPES & SIZES

● In this photo you will find a Johnson Sleeve Bearing of every type used in industry. Various alloys . . . bronze, babbitt or aluminum . . . can be selected . . . and different combinations with bronze or steel are available. Johnson Bronze facilities make possible a size range from tiny bearings up to King Size, 14" OD, 17 inches in length. Since Johnson Bronze produces all the types of sleeve bearings, their engineers can give you unbiased advice on the bearing best suited to your application.

JOHNSON BRONZE COMPANY
769 South Mill St. • New Castle, Pennsylvania

JOHNSON B BEARINGS
Sleeve-Type

Write for Information or for an appointment to discuss your problems.



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REFLECTOSCOPE INSPECTION

Dependable, non-destructive testing is often vitally important even though the need may occur at infrequent intervals or involve relatively few pieces. SPERRY INSPECTION SERVICE makes Ultrasonic Testing economically available under these conditions. You can hire a Sperry REFLECTOSCOPE and the services of an experienced inspection engineer whenever you need them . . . for any length of time from four hours up.

You'll find this service ideal for periodic machinery inspections, testing shipments of raw materials, testing new or pilot-model products, periodic quality checks and countless other applications to elminate on-the-job failure or to prove and improve product quality.

Almost any material can be tested; hidden defects are quickly and dependably located in up to 30 feet and over of solid steel. Write now for complete information.

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☐ Have a SPERRY Representative drop in when in the area.

MATERIAL TO BE TESTED_____
NAME_____
TITLE_____
COMPANY_____
CO. ADDRESS_____
CITY_____ ZONE_____ STATE

Exhibits . . .

(continued from page 193)

Polyplastex United Inc.
Booth No. 19

Exhibit features a new theory of decorative and industrial plastic impregnation process applicable to metal, wood and other basic materials to eliminate porosity; Polyplastex 595 mold release for plastic molding operation and Polyplastex coated materials which are used for a variety of industrial and decorative applications. Some product applications include wall panels, furniture, room dividers, direct and indirect lighting, displays, decorative screens, book covers, blinds, lamp shades, upholstery, shoes, belts, luggage, etc.

Powdered Metal Products Corp. of America **Booth No. 35**

A special exhibit on growth and development of powder metallurgy. The theme of the exhibit is "Progress in Powder Metallurgy". In keeping with this theme, fabricated parts and material properties that represented the best available when powdered metal fabrication was relatively new, 20 years ago, are displayed. Major steps in the progress of the industry, showing its growth over the years, are also represented. High point in the exhibit is the sharply drawn contrast between what is now available through powder metallurgy and what was possible 20 years ago.

Reinhold Book Div.
Booth No. 55-B

Reinhold Book Div. is exhibiting a selected group of technical books pertaining to the technology and uses of metals, nonmetals, metals processing, and chemicals. Orders for books may be placed at the booth. Catalogs and other literature describing all Reinhold books are available.

Reinhold Publishing Corp.
Booth Nos. 55-A, 55-B

See MATERIALS & METHODS and Reinhold Book Div.

Reynolds Metals Co.
Booth No. 45

Reynolds exhibit shows finished aluminum products that demonstrate the latest design techniques with alumi-

(Continued on page 202)

TAM*

● The well-known trademark identifying TAM* products is your assurance of quality and performance. It is backed by experienced research and production in the development of better materials and methods for industry.

Our Field Engineers, plus a well-staffed and equipped laboratory, offer you practical assistance and cooperation on application problems of all types. To expedite service and information, please address inquiries to our New York City address.

TAM PRODUCTS
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TITANIUM ALLOY MFG. DIVISION
NATIONAL LEAD COMPANY
Executive and Sales Offices: 111 BROADWAY, NEW YORK CITY
General Offices, Works and Research Laboratories: NIAGARA FALLS, N. Y.

TAM PRODUCTS
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TITANIUM ALLOYS

Titanium alloys produced by TAM* are used successfully as deoxidizers and stabilizers and as a source of titanium in steels and alloys. The complete experience gained in their development and use is available to you through our field staff and laboratory.

ZIRCONIUM COMPOUNDS

ZIRCONIUM METAL is now available in the form of sponge, briquettes, bars, rods, sheets and wire.

Zirconium compounds produced by TAM* are receiving increasing industrial attention and use.

Zirconium Silicate (Zircon)
Zirconium Oxide
Stabilized Zirconium Oxide Refractories
Zirconium Acetate (Solution)
Zirconium Silicate (Zircon) Refractories
Zircon Silicate Electrical Cements
Zirconium Silicate Precision Casting Cements
Zirconium Oxychloride
Double Silicates

ZIRCONIUM OPACIFIERS

TAM* Zirconium Opacifiers meet every requirement in the highest degree

FOR GLAZED WARE

OPAX*
SUPERPAX*
SUPERPAX A*
ZIRCOPAX*
Calcium Zirconium Silicate
Barium Zirconium Silicate
Magnesium Zirconium Silicate
Zinc Zirconium Silicate
Zirconium Spinel

FOR PORCELAIN ENAMELS

OPAX*
ZIRCOPAX*
SUPERPAX*
SUPERPAX A*
MELTOPAX*
TREOPAX*
SETIT*
ZIRCON MILLED
DOUBLE SILICATES

*Registered trademarks

POWDERMET SUCCESS STORY NO. 12

THE GEAR THAT COULDN'T BE MADE!

Designers specified powdered metal for this two inch helical gear to avoid the high cost of production by conventional methods. But the combination of helical gear teeth with the axial elements of the clutch collar presented an unusual problem in powdered metal fabrication.

That's why they came to Powdered Metal Products Corporation of America . . . the gears, made from a special bearing bronze in production quantities, cost less than fifty cents each!

Write today for complete information on the possibilities of POWDERMET* Gears, both standard and special.

sign of leadership PMP in powder metallurgy

POWDERED METAL PRODUCTS CORPORATION of America

9335 West Belmont Avenue,
Franklin Park, Illinois

*Trademark

Exhibits . . .

(continued from page 196)

num castings, extrusions, structurals and sheet; also the latest fabricating techniques in machining, forming, welding, etc. Examples of industrial aluminum finishes on various design materials are also displayed. A large series of technical books are displayed on all phases of fabricating and designing with aluminum.

Richardson Co. **Booth No. 5**

Display shows the uses being made today of molded and laminated plastics for industrial applications. Also shown are pictures of this company's six plants.

Rigidized Metals Corp.
Booth No. 5-A

Displayed are a complete line of Rigid-Tex metals in many ferrous and nonferrous alloys with a variety of finishes. Some of the patterns stress decorativeness and others stress the structural qualities of Rigid-Tex metal. Among the finishes shown are colorized and highlighted samples and a new type of material which is a combination of vinyl plastic bonded to carbon steel and rigidized. Rigid-Tex Armorply panels, honeycomb panels, and structural sandwich panels are also featured.

Rodney Metals, Inc.
Booth No. 34

The following types of materials are displayed: prepainted strip, including strip finished with high baked enamel that can be blanked, formed, pierced and embossed, and vinyl coated strip that can be deep drawn; extremely thin gage stainless steel—as thin as 0.002 in. and as wide as 24 in.; carbon steel shim stock; precision gage cold rolled strip; various light gage specialty metals.

Rohm & Haas Co., Inc.
Booth No. 39

Main display is a model store showing how acrylics can be used in merchandising equipment. Also shown are parts molded from acrylic molding powders, acrylics as replacements for glass, and a back-lighted luminous ceiling made of acrylic plastics.

(Continued on page 204)

SYNTHANE — making bigger payloads pay off

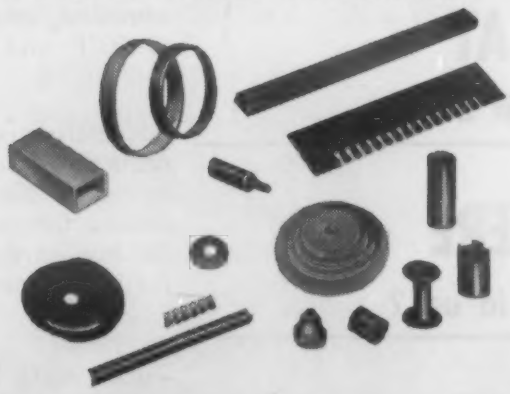
Synthane bushings, spacers, and bearings in the landing gear of this giant of the skies share the landing shock loads of twenty-five tons. But Synthane parts have many virtues in addition to their ability to withstand the jolts of heavy landings.

Parts made of this hard-working laminated plastic are unaffected by oils, and are dimensionally stable. They resist abrasion, and weigh half as much as aluminum.

Because Synthane is so easy to machine, it is appropriate for fair-leads and cable-sheaves in control systems. Because it is an excellent electrical insulator, you will find it at work in engine ignition systems, flight instruments, automatic controls, and radar sets. Because Synthane is light and corrosion-resistant, it's used for the flapper valves in fuel cell baffles.

Synthane has all these properties and many more. It might be a good material for you to try. Start by sending for the complete Synthane Catalog. Synthane Corporation, 5 River Road, Oaks, Penna.

PLACE FOR PLASTICS



Are you ever tempted to regard plastics as "substitute" materials?

Contrarily, plastics are basic materials with properties all their own. Synthane laminates, for example, are characterized by a *combination* of properties useful in industry or industrial applications.

Synthane plastics are hard, dense, tough, moisture- and chemical-resistant, mechanically strong, easy to machine . . . excellent electrical insulators. They're all these and more *combined*. Though thousands of uses for Synthane have popped up, the surface has hardly been scratched.

Synthane—one of industry's unseen essentials

SYNTHANE

LAMINATED PLASTICS

HOW TO SOLVE HOT SPOTS

(UP TO 2200° F)

in products and processes

If improvement of your product or process depends upon use of extremely high temperature, while minimizing its destructive effects, use Kentanium at the critical points.

WHAT is Kentanium?

Chiefly titanium carbide (and small percentages of other refractory metal carbides), with nickel "binder". Uses neither tungsten nor cobalt. Hardness: Up to 93 RA. Weight: ⅔ that of steel.

WHAT can it do?

Resist thermal shock, withstand oxidation and abrasion, retain great strength at high temperatures (1800°F and above).

WHERE is it in use?

Successful applications include: Valves, valve seats, reduction crucibles, anvils for spot welding, hot extrusion die inserts, bushings, thermocouple protection tubes, flame tubes, furnace tong tips, balls for hot hardness testing, nozzle vanes and blades for jet engines, and many others.

WHAT forms are made?

Tubes, rods, bars, flats by extrusion process. More complex parts by machining from pressed slugs before sintering; extremely accurate parts by grinding to required tolerance after furnace sintering.

HOW can you use it?

This remarkable new metal, available in many "grades" to meet specific combinations of imposed conditions, can best be adapted to your high temperature problem by cooperative effort. Our engineers will be glad to discuss how you can get best results from Kentanium..

An Exclusive Development of KENNAMETAL® Inc., Latrobe, Pa.

KENTANIUM

HEAT-RESISTANT, HIGH-STRENGTH, LIGHTWEIGHT CEMENTED TITANIUM CARBIDE

See KENTANIUM demonstration—Basic Materials Show, N. Y.—SPACE 59C

Exhibits . . .

(continued from page 202)

South Florida Test Service
Booth No. 44

Presenting a continuous showing of colored slides depicting facilities and tests at four locations in southern Florida which are: main inland proving grounds, laboratory and storage warehouse; salt atmospheric proving grounds 150 ft from Atlantic Ocean; tidewater immersion test location in sea water; total immersion test location in sea water. Slides show tests on protective coatings, plastics, rubber, textiles, plating, metals and related materials and products.

Sperry Products Co., Inc.
Booth No. 10-A

This display features Reflectoscope equipment used for the ultrasonic testing of materials.

The Sponge Rubber Products Co.
Booth No. 40

Sponge Rubber Products Co. booth features cellular rubber, both open and closed cell, sheets, cord, tube, strips, die-cut shapes and molded forms. Also shown in basic sheet form is Spongex Plastics, a unicellular expanded polyvinyl chloride.

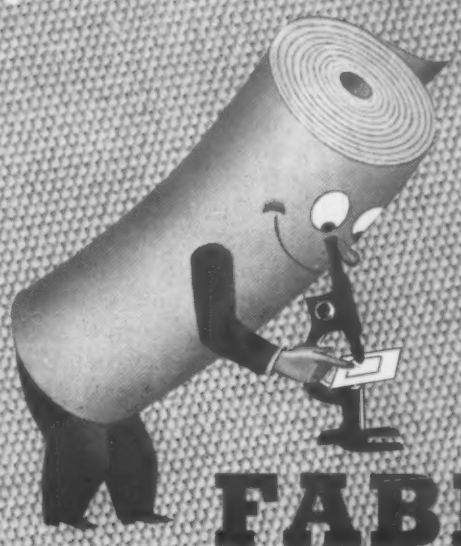
The Star Porcelain Co.
Booth No. 42

Exhibited are hundreds of different shapes and sizes of parts manufactured by Star Porcelain Co., together with complete data on the many formulas produced. Also shown are several applications of their ceramic material on completed assemblies.

Stupakoff Ceramic & Manufacturing Co. **Booth No. 37**

Featured in the Stupakoff exhibit are the following materials: Kovar alloy for sealing to glass. Ceramic products —insulating, refractory and thermal shock types, featuring a ceramic of zero expansivity capable of cycling from 0 F to 2000 F without breakage. Temperature sensitive resistors. Metal-ceramic assemblies. Glass-metal assemblies. The exhibit includes demonstrations of Stupalith and temperature sensitive resistors and a wide variety of samples of products for electronic, chemical, electrical and kindred industries.

(Continued on page 206)

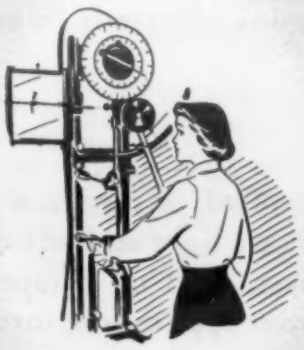


WHAT'S YOUR INDUSTRIAL FABRIC PROBLEM?

Need some expert advice on the right fabric for your special needs? Want a NEW fabric developed for a particular purpose—cotton, synthetic or blend—or an existing fabric adapted to a new application? We believe you'll find Mt. Vernon-Woodberry has the skill and experience it takes to work it out. Can we help?

UNIFORMITY MAKES THE BIG DIFFERENCE

Determining Yarn Tensile Strength with 300-lb. vertical test. One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products.



STANDARD FABRICS

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Double and Single Filling
Hose-Belting and Shoe Duck
Filter Cloths
Dryer Felts
Narrow and Wide Drills
Twills

AT YOUR SERVICE

Mt. Vernon-Woodberry Mills staff of textile engineers is available on request to help you with your problems in development or application of industrial fabrics.

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Here's what micarta® LAMINATED PLASTICS is doing for automobile engines!

A leading automobile manufacturer wanted a timing gear that was slow-wearing, silent in operation, low in cost. Now, more than six million MICARTA timing gears are performing efficiently in engines.

What can Micarta do for you?

Your problem may be as simple as noise control, or electrical insulation. Perhaps you need a material that is both light and strong, that resists corrosion, withstands vibration, heat, cold or compression. Whatever your problem, your industry, or your application, investigate the qualities of versatile MICARTA.

For prompt and complete information, fill out the coupon below.

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micarta is basic!

Westinghouse Electric Corporation
MICARTA Division, Trafford, Pa.
Attention: L. A. Pedley
Sir: (Please check one)
☐ Please have your representative call
☐ Please send me the complete facts on MICARTA
Name_____ Company_____
Address_____
City_____ Zone___ State_____
J-06511

Exhibits . . .

(continued from page 204)

Superior Steel Corp.
Booth No. 69

Superior Steel Corp. exhibits stainless and clad strip steels of the company's manufacture, and a large number of products fabricated from these metals. Featured in the display are Superior's Type 302 and Type 430 stainless strip steels, and copper and brass clad Superior SuVeneer Clad Metal. The latter products are bi-metallic strip—an outstanding specialty of Superior—wherein copper (or brass or other metals) is bonded inseparably to one or both sides of a plain steel core.

Superior Tube Co. Booth No. 79

A wide variety of small diameter precision tubing in many analyses—carbon, alloy, stainless, nickel and nickel alloys, beryllium-copper and titanium are on display at the Superior Tube exhibit. Types of tubing displayed include hypodermic needle, bourdon, hydraulic, super pressure, micro-precision, mechanical, and special shaped tubing. One panel of the exhibit shows representative samples of tubing for the aircraft, diesel, electronics, chemical and metal working industries. Of special interest is the panel featuring Superior's latest research and development samples of commercially pure and alloy titanium tubing.

Sylvania Electric Products, Inc.
Booth No. 49

This exhibit consists of three parts: 1) assembly operation of plastic spouts for lighter fluid cans and caps. 2) Wire drawing operation producing tungsten wire ½ mil in dia. 3) Model of atomic energy power generating station.

Synthane Corp.
Booth No. 28

Synthane Corp. is represented with a display of thermosetting laminated plastic materials and fabricated products. Of particular interest to the manufacturer, designer and engineer is the wide variety of grades and forms of Synthane standard stock. Examples of Synthane's fabricating skill is also demonstrated by a display of complex parts currently being produced for a great number of industrial applications. Among these are a number of molded macerated and molded-laminated parts.

(Continued on page 208)

For Critical High Voltage Applications ... Frenchtown Ceramic Bodies

You are invited

to visit us in

BOOTH 328

at the

BASIC MATERIALS SHOW

2570

ZIRCON MULLITE

An economical, all-around, white spark plug insulator body with exceptional dielectric strength, low thermal expansion and correspondingly high shock resistance.

3569

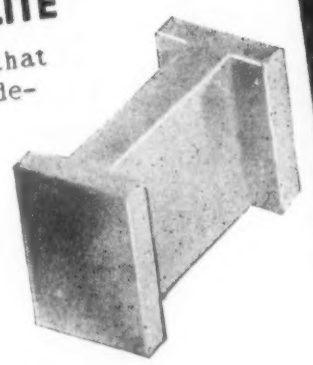
ZIRCON

A white ceramic similar to 2570 with high dielectric strength and better electrical resistance at high temperatures. Extremely high impact resistance after thermal shock.

7873

ALUMINA MULLITE

An excellent white porcelain that gives the engineer leeway to design intricate shapes that must provide good mechanical strength, thermal shock resistance and thermal conductivity.



6096

ALUMINA

A white body, similar in structure to 7973, adaptable for use in high compression engines. It has very high mechanical strength and thermal conductivity. Its thermal shock resistance is correspondingly good.

4462

HIGH ALUMINA

A brown ware with exceptionally high impact, compressive, and flexural strength. Used largely in aircraft, particularly for spark plug insulators. Has excellent electrical properties at high temperatures, and superior abrasion resistance.

FRENCHTOWN PORCELAIN CO.

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Factory: Frenchtown, N.J.

Producers of

Metal Powders

Copper Powder
(ELECTROLYTIC GRADE)

Atomized Copper Base Alloy Powders

Solder Powder

Silver Powder

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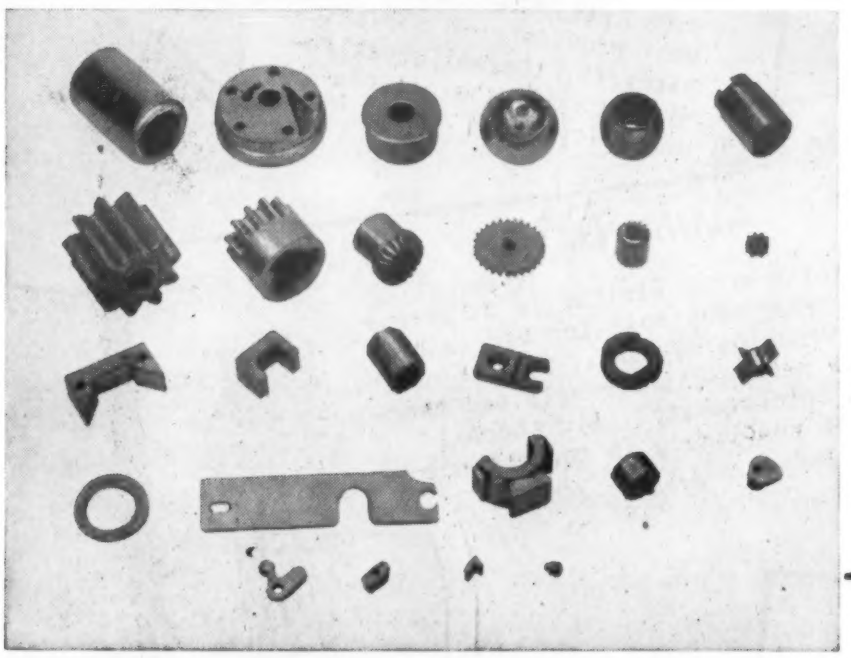
For further information address us at Room 2813.

THE AMERICAN METAL CO., LTD.

61 BROADWAY, NEW YORK 6, N. Y.

Got a Part Problem?



Try Metal Powder Parts!

Save time, money and machining operations by using Metal Powder Parts. We work to close tolerances and are equipped to engineer and produce a variety of shapes in materials tailored to your requirements . . . fast and at reasonable cost.

Write, wire or phone.
No obligation, of course.

Metal Powder Products, Inc.

413½ W. Fifth St. Phone Michigan 0396 Dayton 2, Ohio

Exhibits . . .

(continued from page 206)

Taylor Fibre Co. **Booth No. 64**

Taylor Fibre Co. presents, in three sections of the booth: (1) The basic materials which Taylor makes for industry—vulcanized fibre, Taylor insulation, phenol laminates, melamine laminates, silicone laminates and combination laminates. (2) A great variety of component parts fabricated from these basic materials for a wide range of application throughout industry. (3) Complete assemblies of products manufactured by the leaders of industry utilizing, in many cases, a variety of the materials mentioned in item # 1 of Taylor manufacture.

Time Magazine **Booth No. 2**

Time's new exhibit, "Time Opens the Doors to Industry," is being shown publicly for the first time. It combines the appeal of audience participation with a look at Time's penetration of the industrial market.

United States Testing Co.
Booth No. 4

This exhibit demonstrates what U. S. Testing Co. can do in the evaluation of basic materials and how this evaluation can bridge the gap between the raw materials and the way in which they are used; also how U. S. Testing can develop the "Know How" or suitability of basic materials to their application or end use. In addition, instruments will be displayed which are necessary in evaluation developing and applying basic materials in manufacturing processes.

Western Felt Works
Booth No. 72

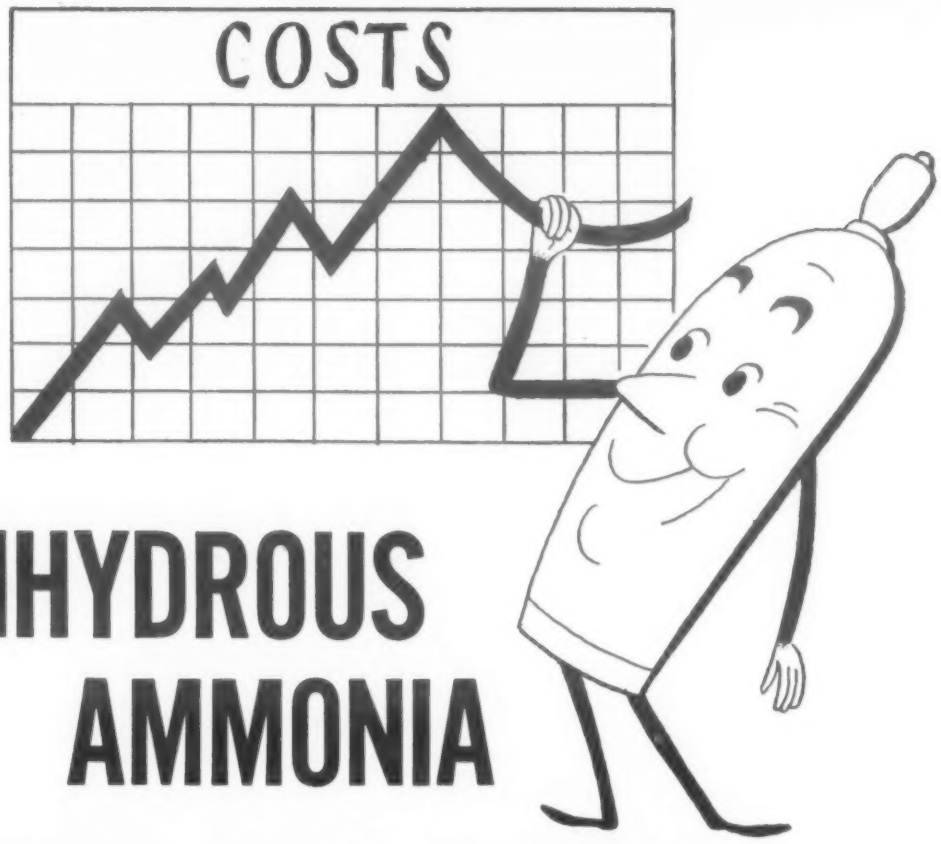
A display of the variety of felt products produced by this company.

Wisconsin Centrifugal Foundry, Inc. **Booth No. 62**

The Wisconsin Centrifugal Foundry booth contains actual castings on display, panoramic pictures, working models and new publications for distribution. The actual castings indicate the many fields of use where centrifugal castings are eminently suited.

(Continued on page 210)

You are busy, so why bother with details now. 'Extruded Plastics', a 12 page brochure just published is available free to those interested. Write to Anchor Plastics Co. Inc., 36-36 36th St., Long Island City, N.Y. Custom Precision Extrusions in Thermoplastics.



ANHYDROUS AMMONIA

SAVES YOU MONEY!

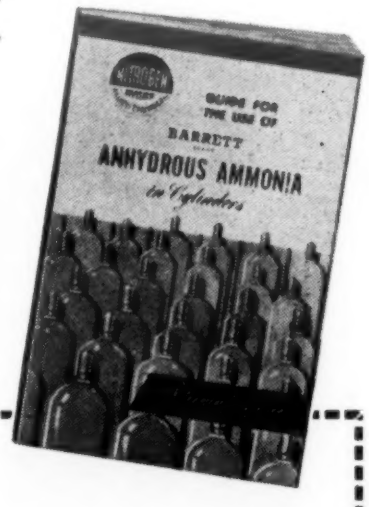
Barrett® Brand Anhydrous Ammonia is one of the most economical sources of hydrogen and nitrogen for metallurgical uses.

When partially dissociated, Anhydrous Ammonia is used in the nitriding of alloy steels and in carbonitriding for treatment of steel. Carbonitriding, often referred to as "Dry Cyaniding," has in many instances replaced the liquid cyanide bath to economically produce cases on low carbon steels.

Dissociated, or "cracked," ammonia is used as a protective atmosphere for bright annealing, brazing and powder metallurgy. It is also used as hydrogen for welding, for descaling metals by the sodium hydride process, and as an economical source of hydrogen in electronics. In addition, it is used in the hydrogenation of fats and oils.

NITROGEN DIVISION ALLIED CHEMICAL

Write for full information on how Barrett® Brand Anhydrous Ammonia can save you money. The advice and help of our technical men are available to you without charge.



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FROM TOYS TO TANKS

STEEL GM tubing

SOLVES PRICE AND PRODUCTION PROBLEMS

It's a far cry from a child's toy to a mighty weapon of war—yet GM Steel Tubing plays an important part in the design and building of both. In hundreds of other products, too, this low cost steel tubing serves to advantage either for the passage of liquids or gases, or as part of the mechanical structure.

Every day Rochester Products turns out *hundreds of miles* of GM Tubing in one of America's most modern and best equipped plants. Into every inch of its manufacture go the skill and engineering "know how" gained through nearly 20 years of General Motors research and development.

Whether you are designing new products or re-designing old ones, it will pay you to investigate the time-and-money-saving features of GM Steel Tubing.

WIDE RANGE OF SIZES AND FINISHES

GM Steel Tubing is available in welded single wall or copper brazed double wall construction, in sizes from ⅛" to ⅝" O.D., and in straight lengths or in 120′ to 1000′ continuous coils. Choice of plain, Terne coated, copper plated, or Fuse-Kote (copper fused) finish.

EASILY FABRICATED

GM Steel Tubing not only lends itself readily to intricate bending but also to all types of fabricating operations—crimping, beading, perforating, swaging, expanding, drawing, flanging, flattening, knurling, threading. Rochester Products offers complete fabricating facilities, including the services of experienced General Motors engineers.

SEND FOR FREE BROCHURE

Our new illustrated brochure, entitled *"Look Ahead with GM Tubing,"* tells why GM Tubing is first in the field for lasting quality, adaptability and low cost. Send today for your free copy.

GM STEEL TUBING

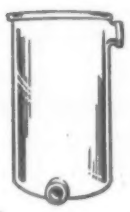
ROCHESTER PRODUCTS *DIVISION OF GENERAL MOTORS*

Rochester, N. Y., U. S. A.

"Made-to-Order" for CORROSIVE SERVICE

Towers, absorbers, scrubbers

Pipe, duct and fittings



Jars, tanks, sumps, trays

Separators, mixing kettles, surge tanks

The large diameter ductwork above is "made-to-order" for handling corrosive fumes because it is made of Permanite.

Permanite is a furfural alcohol resin structural material reinforced with chemical Fibreglass, which can be formed to almost any shape. It is light weight but very strong and tough and presents a hard non-absorbent surface. Permanite Equipment is corrosion proof throughout its entire body. It will handle most acids including HF, HCl, as well as oil, alkalies and organic solvents to 280° F.

Permanite is used in the construction of many types of chemical handling equipment, large and small. Although individually engineered, Permanite equipment is relatively low in cost and economical in operation. Because of its light weight, it offers an added advantage of speed and facility in handling, shipping and erecting. It is being used for handling corrosives in just about every chemical process industry.

Send for illustrated Bulletin No.6-0 Permanite Equipment, or Bulletin No. 1, Permanite Pipe and Ductwork, and learn how Permanite can help solve your corrosion problems.

Maurice A. Knight 7406 Kelly Ave., Akron 6, Ohio

Acid and Alkali-proof Chemical Equipment

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June 16-18, New York City

Hear authorities speak on:

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- Materials for high strength with low weight
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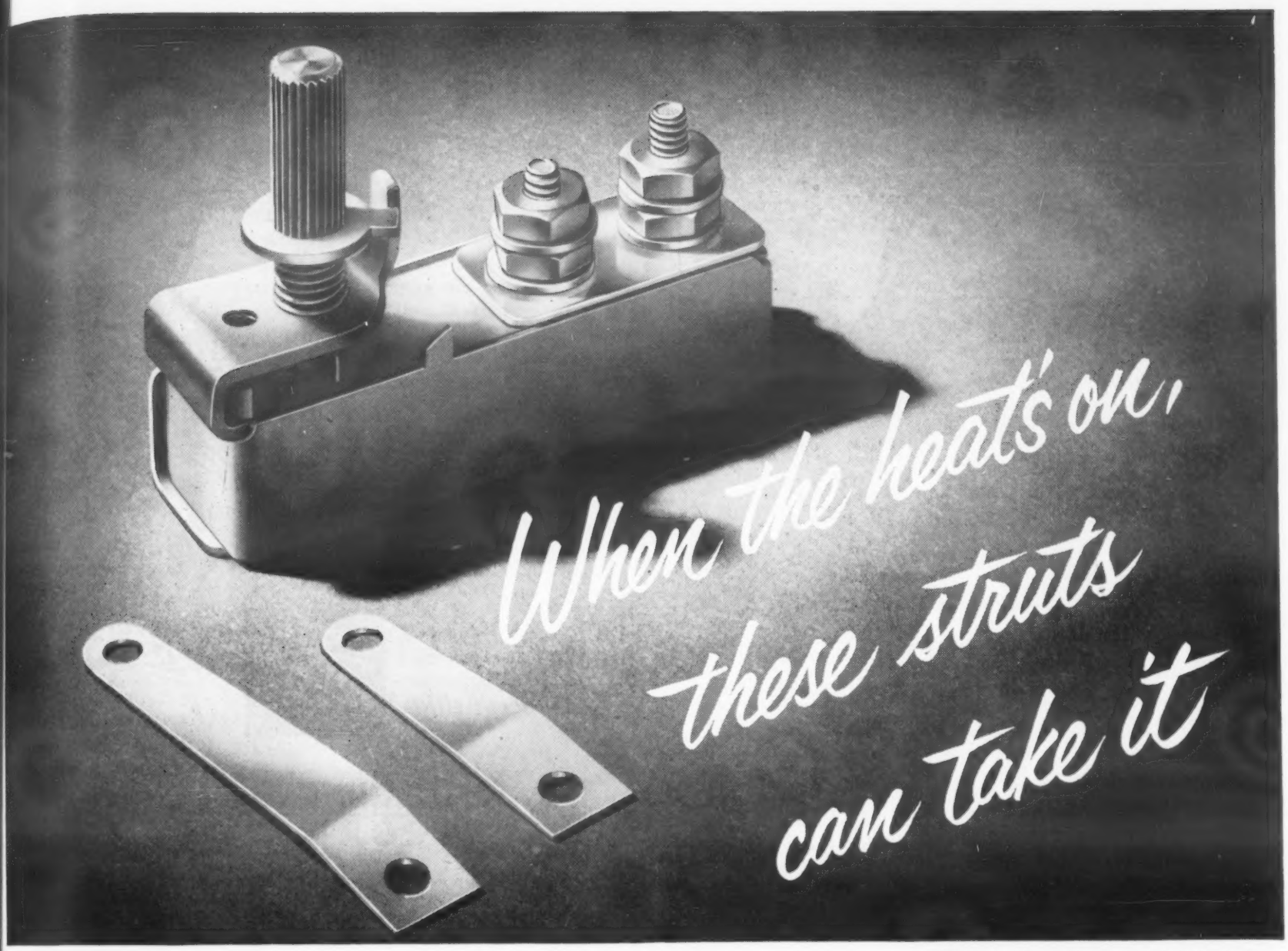
- Materials for electrical and electronic service
- Magnetic materials

Also hear sessions on:

- Materials specifications and management
- Economics of engineering materials
- Materials utilization

All Conference sessions will be held in the Grand Ballroom, The Roosevelt Hotel (45th St. at Madison Ave.).

See page 149 and 151 for detailed list of papers.



*Product of Fenwal Incorporated, Ashland, Mass.

THEY'RE MADE OF BERYLCO BERYLLIUM COPPER

These Berylco parts are struts—or contact supporting members—used in Fenwal's low-temperature appliance switch.*

This appliance switch is a practical, sensitive and accurate device for controlling temperatures. In household irons, for instance, it is used to provide a range of 50 to 300°F. It maintains constant temperatures for such appliances as pasteurizers and dryers.

The qualities demanded in this application—elasticity and thermal and electrical conductivity—are such that no other material would do. It is a must that the strut return to its original shape when tension on it is released. No other material with the desired electrical conductivity can provide these deflection characteristics at the temperature involved. Thermal conductivity is also desirable—to enable the heat developed by the contact points to be dissipated.

The unique properties of Berylco—its combination of strength and conductivity, its marvelous spring properties, its endurance, its ready formability—are making better, cheaper products for hundreds of manufacturers the country over. If you would like to include Berylco in your plans for the future, we invite you to share the know-how of the world's largest producer of beryllium copper. For engineering help or sample material, call or write any of the offices listed below.

THE MOST COMPLETE LISTING of available beryllium copper forms is contained in the recently published Berylco *Product Directory*. Send for your free copy today.

TOMORROW'S PRODUCTS ARE PLANNED TODAY—WITH BERYLCO BERYLLIUM COPPER

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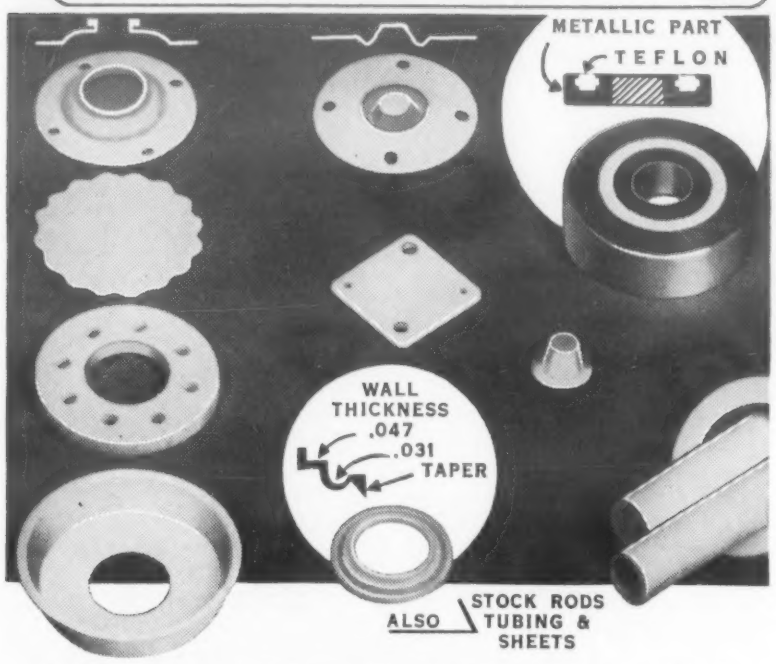
GOT A TOUGH ONE IN TEFLON?

CONTACT SPARTA, SPECIALISTS IN TEFLON MOLDING



Above, some recent Teflon moldings by Sparta. Represented are Diaphragms, Special Washers, Discs, Seals and Cup Seals with difficult undercuts, varying wall thicknesses, other physicals formerly thought impossible to mold in Teflon.

Perhaps YOU can improve products, processes and profits with Teflon MOLDED TO YOUR SPECIFICATIONS. Sparta offers painstaking cooperation, no obligation . . . just write or call

SPARTA HEAT TREAT CO.
PLASTICS DIVISION,
EAST SPARTA, OHIO
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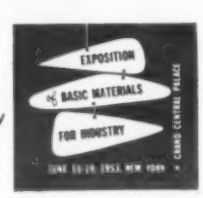
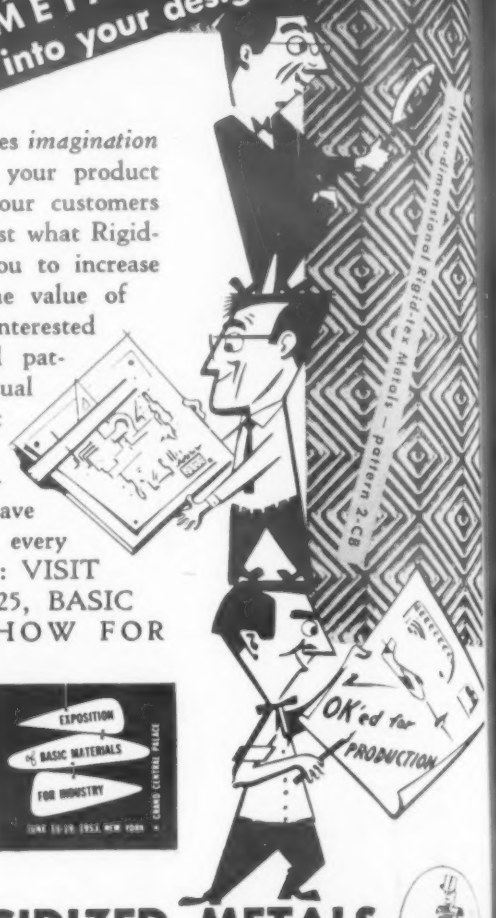
(CANTON, OHIO EXCHANGE)

RIGID-tex METALS put IMAGINATION into your designs

• it takes *imagination* to put into your product all the benefits your customers want . . . and that's just what Rigid-tex Metals can give you to increase the eye-appeal and the value of your ideas. if you're interested in design-strengthened patterns that have unusual decorative appeal, resist and conceal damage, reduce weight yet increase strength and have been used in nearly every product under the sun: VISIT US AT BOOTH 225, BASIC MATERIALS SHOW FOR INDUSTRY

send for your Design Imagineering Folder . . . on company letterheads, please.





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For more than 40 years, we at Cleve-Weld have specialized in the mass production of rolled or welded circular steel parts. Constantly seeking ways to do this one job better—and at the lowest possible cost—we have designed and built much of our own production machinery and equipment.

Our engineers and metallurgists are experts at designing circular parts and weldments for maximum strength without unnecessary weight. Our long-experienced production specialists can turn those designs into parts of amazing uniformity...at a cost which may show you surprising economies.

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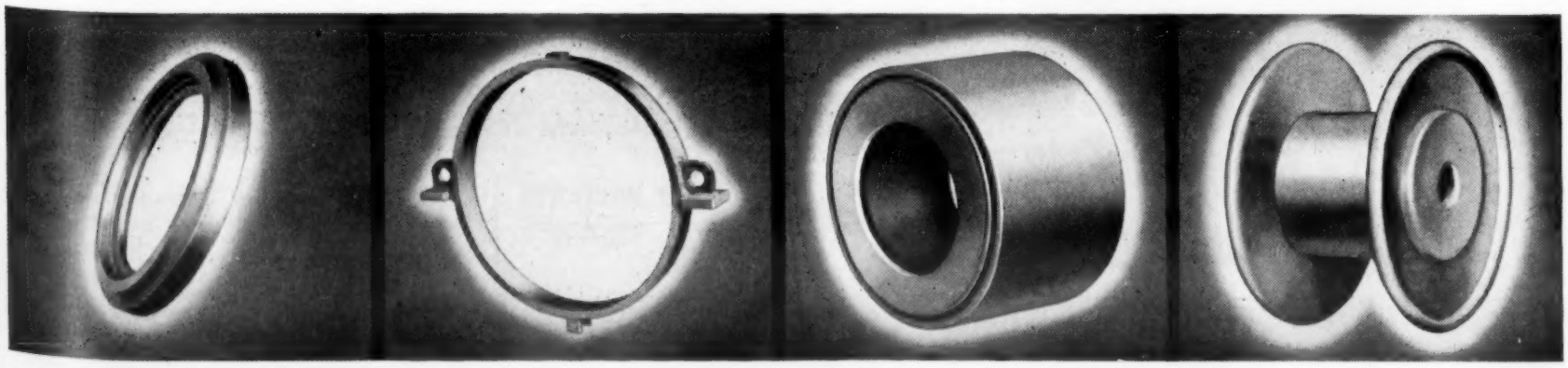


Gasket Materials to Tolerances of ± 5%

Asbestos-rubber gasket materials by Rogers Corporation feature superior thickness control plus homogeneity and dimensional stability.

You can specify ±.002" for thicknesses up to .031" and ±.003" for gauges up to ⅛", for most grades.

UNIFORM AND PRECISE THICKNESS of Rogers DUROID gasket materials assure even compressibility over entire surface of the packing. Now your allowances for gasket thicknesses can be actual — not wishful — and fastening torques can be standardized, an advantage that gains in importance as assembly operations are increasingly mechanized.

MADE BY THE BEATER SATURATION METHOD, a manufacturing technique in which Rogers has maintained leadership since 1932, DUROID gasket materials are thoroughly mixed in a water slurry. Asbestos fibres are blended with the rubber to form a homogeneous sheet, free of pressure-weak lumps of uncoated fibre.

OFFERING AN AMAZINGLY HIGH RATIO of tensile strength to density, DUROID gasket sheeting is available in three series of materials. In each series, formulations can be varied quite easily to meet specific requirements for compressibility and recovery.

DUROID 3100 SERIES — Neoprene-base asbestos recommended for use with oil, gasoline, freon and in water systems with anti-freeze. DUROID 3102 conforms with Spec. MIL-G-7021, Class 2 and AMS 3231.

DUROID 3200 SERIES — Buna-N and asbestos recommended for oil, aromatic and non-aromatic fuel systems in which high temperatures and high pressures will be developed. DUROID 3200 conforms with AMS 3232F requirements.

DUROID 3300 SERIES — GR-S and asbestos recommended for water, anti-freeze and steam systems. Will swell in oil or gasoline applications.

FOR ALL GRADES
Gauges: .015" to ⅛". Sheet size for .015" is 25" x 72"; for all other gauges sheet size is 50" x 72".

Rogers supplies DUROID gasket materials in sheets or in fabricated form, plain or graphite-coated. For test data, please write Dept. M, Rogers Corporation, Manchester, Conn.

Better Parts for Better Products

ROGERS CORPORATION

Established in 1832

YOU NAME IT — WE'LL MAKE IT — AND FABRICATE IT, TOO

DUROIDS for Gaskets, Filters Electronics . . .

ELECTRICAL INSULATION for Motors, Transformers, Generators . . .

PLASTICS Molding Compounds and Laminates

SHOE MATERIALS for Counters, Midsoles, Liners

YOU SAVE WHEN ROGERS FABRICATES FINISHED PARTS

New Materials and Equipment

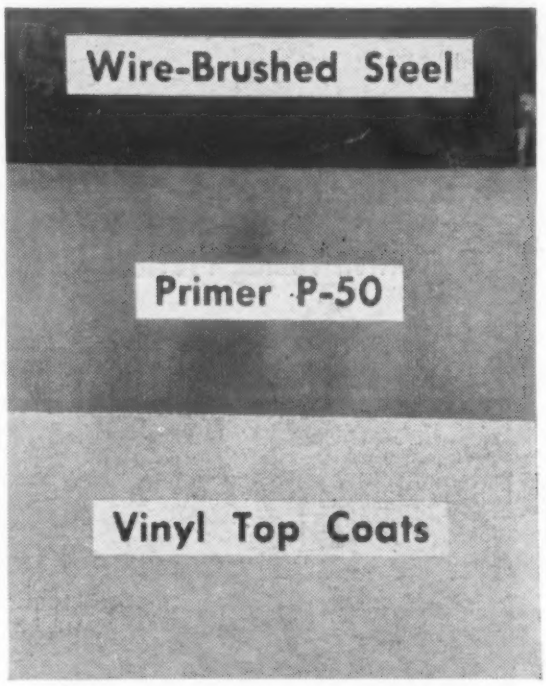
New Vinyl Coating Technique Offers Many Advantages

According to *Prufcoat Laboratories, Inc.*, 50 E. 42nd St., New York 17, traditional vinyl coating handicaps of poor adhesion, low "build", impractical surface preparation and priming requirements, are now eliminated through the use of a new vinyl coating system. The company's new CP Vinyl System combines the highly desirable properties of a heavy-duty, drying-oil primer with the well-known chemical resistance advantages of vinyl coatings. In addition to its highly prized drying-oil properties, the newly developed Prufcoat Primer P-50 is specifically formulated for use with active-solvent synthetics, and particularly with vinyl coatings.

By affording substantially greater edge build than heretofore possible with vinyl coating primers, Primer P-50 serves effectively to safely lower the optimum thickness for plane areas to 4 mils. It automatically provides for faster and heavier "buttering up" of all surface irregularities, insuring high probability of long service at all failure-sensitive edges and projections while at the same time radically lowering the total system thickness it is necessary to attain. Yielding in one coat approximately 2 mils dry film thickness on flat areas, Primer P-50 is not handicapped with the characteristic high surface tension of the typical synthetic coating and has far less tendency to draw thin over prominences. Its relatively low surface tension, heavy body and high total solids enable the system to protect all vulnerable points, as well as plane areas, in a simple, economical and practical 3-coat application.

Enjoying the well-known advantages common to drying-oil primers, Primer P-50 displays excellent all-around adhesion properties. It bonds securely to most metals—iron, steel, aluminum, magnesium, brass, bronze, etc.; and like primers of the red lead and oil variety, also can be depended upon to perform satisfactorily over old, corroded, wire-brushed metal.

In addition to coating thickness and adhesion requirements, there remains another important consideration that bears directly on long service life. This is the factor of providing for the control of underfilm corrosion and rust creepage. The drying-oil type vehicle used in Primer P-50 and its heavy pigmentation with zinc chromate and other carefully selected inhibitive pigments eminently qualify the new primer in this respect. According to the company, steel test panels prepared with one coat of Primer P-50 and one top coat of "A" Series Prufcoat and then scored to expose the bare metal and the panels subjected for 672 to a 20% salt spray, the acidity of which was adjusted to pH 3, showed no failure anywhere on the Prufcoat primed and painted surface, and no corrosion creepage under the coatings at score marks.



A new vinyl coating system combines advantages of a drying-oil primer with chemical resistant advantages of vinyl coatings.

Application is simple, practical and economical. Plant painters handle the new primer in exactly the same way they would the most conventional of industrial primers. Metal surfaces are prepared in accordance with the established standards for conventional industrial paints. Normally this means only simple wire-brushing and scraping to remove loose rust, scale and other corrosion products.

New Pre-Impregnated Glass for Low-Pressure Laminating

Electro-Technical Products Div., Sun Chemical Corp., has announced the development of Sunform, a new low-pressure laminating material. Sunform, which is glass cloth uniformly impregnated with polyester resin plus catalyst, is ready for forming just as it arrives from the factory, and it easily unrolls like a roll of cloth.

The material's flexibility and tack make lay-ups easy. Available in fire resistant white and regular clear, Sunform cures completely in 2 to 5 min. at 250 to 300 F. High tensile and flexural strength combined with light weight make it one of the strongest structural materials available for molding by matched dies, vacuum bag, pressure bag and contact pressure. Sunform resin flows freely, resulting in void-free laminates even from the most intricate molds. The resulting strong bond eliminates delamination during all types of machining operations.

No refrigeration is necessary to store the material—it can be stored for six months at normal room temperatures up to 70 F.

New Materials and Equipment continued

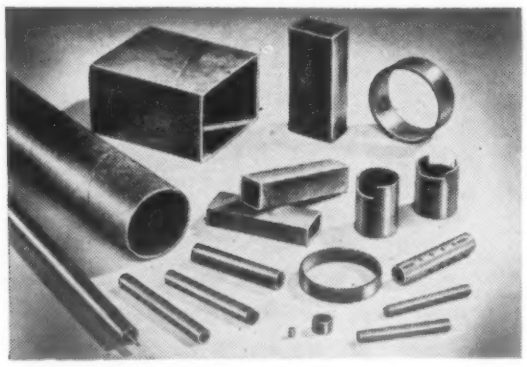
Phosphatizing Material Promotes Good Adhesion of Paint to Metal

Oakite Products, Inc., 157 Rector St., New York 6, has announced the development of Oakite CrysCoat HC, a phosphatizing material which creates a complex zinc phosphate coating on steel and iron to promote excellent adhesion of paint to metal.

According to the company, the material provides a coating that is crystalline in nature and has a weight ranging from 200 to 1200 mg per sq ft, depending upon how it is applied and the type of steel being treated. It can be used in tanks and in pressure-spray washing machines, and with both methods, the following Government Specifications are fully met: JAN-C-490, Grade I; 57-0-2C, Type 2, Class C; and PA-PD-191 Rev. A.

Salt spray resistance of painted parts treated with CrysCoat HC is said to exceed the requirements of these Government Specifications. An outstanding feature claimed for the product is that sludging and scaling are held to the absolute minimum. Another advantage is that an all stainless steel tank set-up is not necessary. A third important feature is its simplicity in use. Only one material is involved—CrysCoat H^e. No special additives or toners are needed. Upkeep is determined by a simple titration procedure, with the equipment for this being supplied by the company.

Composition Tubing Provides Increased Tensile Strength, Improved Dielectric Properties



Composition tubing, providing increased tensile strength and improved dielectric properties, is available in all shapes, widths and lengths.

Resinite tubing, developed by *Precision Paper Tube Co.*, 2035 W. Charleston St., Chicago 47, is said to provide greatly increased wall strength, improved dielectric and other electrical properties, as well as high chemical and moisture resistance. Tubes are available in all shapes, widths and lengths. These include round, square, rectangular and oval. Inner diameters range from 0.125 to 3 in., with wall thicknesses from 0.006 to 0.100 in.

Resinite tubes can be supplied threaded inside or outside, slotted, punched or embossed. Threaded coil forms incorporate a special 3-row design to afford axial pressure in excess of 25 lb. Torque can be controlled to ±1-in. oz. This is a highly desirable feature from the standpoint of torque control, since it eliminates wobble or freezing of cores, thus permitting accurate, as well as frequent coil adjustment.

Tubes can be slotted to specifications for flyback transformers. Special small I.D. sizes are available for use as screw insulators in relays and transformers where high quality insulation is essential. Heavy wall tubes provide adequate tensile strength for use as shafts in electrical or electronic applications in which metal might produce undesirable inductive effects. Due to their chemical and moisture resistant properties, tubes of the large O.D. size are being successfully used in paint rollers for both water and solvent base paints.

Three grades of tubing are available: punching, embossing and coil forming.

New Neoprene Cold Bond System

Of importance to industry is the fact that a uniform sheet of cured neoprene can now be successfully bonded to equipment with ease. No critical application characteristics are involved, according to *Gates Engineering Co.*, P. O. Box 1711, Wilmington, Del., with the use of the Gaco Neoprene Cold Bond System. No critical temperatures and pressures, no critical curing time, and no critical interval for drying and applying primer, bonding agent or sheet are involved.

Basis of the system is a neoprene liquid N-29. When accelerated with Gaco Accelerator N-39 in the proportion of 8 fluid oz per gal, and cured for six days at room temperature, it develops a tensile strength of 2000 psi. Elongation after five days at room temperature cure is 800%.

Gaco N-29 is said to be capable of achieving a bond to clean metal in the order of 35 lb per in. of width, per in. per min. A special Primer N-11 is used over the metal immediately after sand blasting to prevent any reoxidation. This primer is extremely stable, can be sprayed or brushed, and requires a drying time of only a few minutes. The bond achieved by means of Gaco N-29 is not critical as to application techniques or outside temperatures. Like the Primer N-11, it can be sprayed or brushed in any atmospheric conditions in which workmen are likely to work; and the sheet stock can be applied immediately after solvent evaporation, which normally would take about one-half hour. Cured film thicknesses of 1/16, 1/8 and 3/16 in. are available in single applications. Any ultimate thickness desired is readily obtained by merely using multiple sheets bonded to each other by use of cold bond agent N-29.

Ease of repair of mechanically damaged areas is one of the practical advantages of the system.

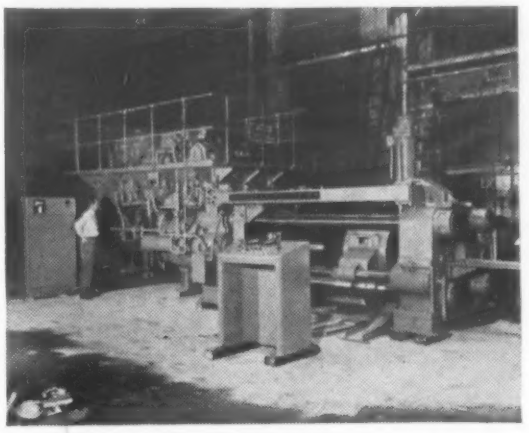
According to the company, the system is not to be compared to the use of cold adhesives and cements. The neoprene bonding agent actually cures rapidly at room temperature, and the entire covering becomes a homogeneous mass of neoprene.

Aluminum Extrusion Press Handles Billets up to 24 In.

A new modern 1250-ton long stroke aluminum extrusion press, manufactured by *The Watson-Stillman Co.*, division of *H. K. Porter Co., Inc.*, Roselle, N. J., is said to incorporate the latest design features and to be capable of handling billets up to 24 in. in length. It is hydraulically operated, 4-column type, equipped with oilgear radial piston pumps.

The long stroke design of the main cylinder permits loading billet and dummy block into the container on a single forward stroke of the main ram. The ram moves at the rate of 8 in. per sec and loads a 24-in. billet and dummy block in 4 sec.

The die slide has a "U" shaped opening for mounting the die ring and bolster, which enables die changing to be accomplished in a matter of seconds. Sequence of operation is semi-automatic with interlocks to protect all mechanisms and limit switch adjustment for setting thickness of butt. Control buttons are also provided for manual operation. The control pulpit is equipped with a speed control lever which permits stepless speed variation of the main ram. It gives the operator fingertip, sensitive control of the press at all times.



This aluminum extrusion press is hydraulically operated, 4-column type, equipped with oilgear radial piston pumps.

Ultra-High-Frequency Insulating Material

Polypenco Q-200.5 (*Polymer Corp.*, Reading, Pa.) is a clear, rigid, transparent, ultra-high-frequency insulating material which is said to meet the need for a lower cost ultra-high-frequency insulator. Applications include commercial and military electronic, communication and allied equipment where a stiffer material than Teflon is required. The newest in the family of Polypenco industrial plastics, which include nylon, Teflon, Kel-F and Nylasint, the material's electrical properties are said to be outstanding for a thermosetting polymer. The low dielectric constant of 2.4 to 2.5, along with only a slight change in the dissipation factor (less than 0.0002 at 30 megacycles) over the entire frequency range, readily meets the requirements for the MIL-P-77A (Type E-2) specification. Being rigid, the new material will also find many applications where other insulators failed, or were not satisfactory because of cold-flow properties.

Machinability of Polypenco Q-200.5 is said to be excellent. It is readily drilled, turned, milled, ground or polished on standard metal-working equipment. The relatively infusible nature of the material means that it does not soften or "gum-up" from heat generated during a machining operation. The same cutting tools as used on brass are recommended. Where a high polish is required, it is recommended to use a lubricated cloth buffing wheel.

Polypenco Q-200.5 insulators have been subjected to temperatures up to 400 F when light mechanical loads are involved. The heat distortion temperature, based on 170 psi fibre stress and a 0.005-in. deflection of a 0.100-in. thick section, is 216 to 225 F.

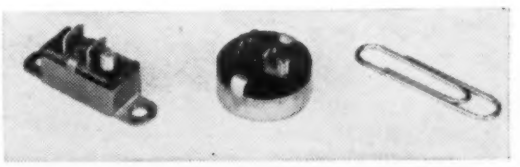
Miniature Thermostat for Precise Temperature Control

A miniature Thermoswitch, available in both rectangular and cylindrical models for design convenience, has been announced by *Fenwal Inc.*, Ashland, Mass., for precise temperature control and overheat detection in instruments and precision mechanisms where minimum volume and weight are important.

Depending upon the thermal and electrical characteristics of the particular system, temperautre control to within 1 F is said to be readily attainable, since the inherent thermostat sensitivity is actually less than 1 F. Either model can be set at any temperature in the range from O F to 200 F by turning an adjusting screw.

A high resistance to vibration permits the miniature units to maintain accurate control under vibration conditions of 5 G's at 50 to 500 cycles per sec. Both the rectangular and cylindrical models are rated at 2.5 amp at 115-v a.c. or 2 amp at 28-v d.c.

The electrical contacts of both models open when rising temperature reaches the set point. The body dimensions of the rectangular thermostat on the left in the photo are ¾ by ⅜ by 11/32 in. The cylindrical model (center) has a body diameter of ¾ in. and is 11/32 in. thick. Various types of mountings are available for both models.



Temperature control to within 1 F is said to be readily attainable with thermostat models shown here.

New Materials and Equipment continued

Fluid tight rivets are now being used for repair and maintenance in the aircraft industry with good results.

Fluid Tight Rivets Seal at Full Strength

Production and maintenance rivet-sealing of aircraft and industrial structures where losses of fluids or pressures would be critical has been made easier and more efficient by use of self-sealing Fluid-Tight rivets manufactured by *Pastushin Industries,* 501 Prarie Ave., Hawthorne, Calif.

Developed for use by aircraft manufacturers and airlines for repair and maintenance of aircraft sealed assemblies, including integral wing fuel tanks, pressurized cabins and fuselages, and hulls and pontoons of flying boats and amphibians, these rivets save time and money and do a better sealing job whenever full-strength, dependable, leak-proof riveted joints are needed. The rivets are modified close-tolerance standard flush-head AN 426 or roundhead AN 430 aluminum alloy rivets and are available in a variety of sizes.

Possessing full rivet strength values, Fluid-Tight rivets can replace standard AD rivets without loss of joint efficiency. Installation is by conventional riveting tools and methods. The rivets are fully approved by the Air Force, Navy and CAA.

New Protective Finish for Magnesium

Allied Research Products, Inc., 4004 E. Monument St., Baltimore 5, has announced the addition of Iridite #15 (Mag-Coat), a new protective finish for magnesium, to its line of protective finishes for zinc, cadmium, aluminum and cuprous alloys.

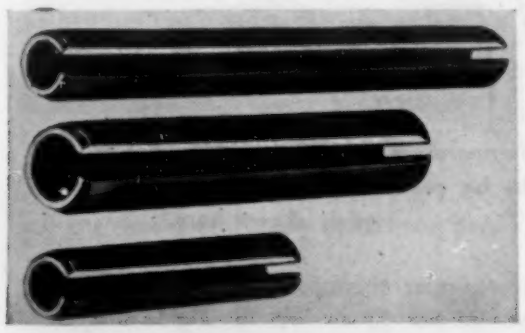
The new finish is a chromate conversion coating. That is, it converts the surface of treated magnesium to an entirely new, and chemically different surface. The film is said to be highly resistant to atmospheric corrosion, as well as to corrosion from some chemical sources. It is an integral part of the metal itself, rather than a superimposed film. Thus, it will not chip, flake or peel when bent. A slight dimensional change is caused by treatment with the finish, the degree depending upon time of immersion.

The film is produced by simply immersing the parts in the Iridite solution. The solution operates at ordinary room temperatures and without the need for electric current. No special equipment is required and no specially trained operators are needed. A slight amount of fuming will be noticed when magnesium parts are immersed in Iridite #15. This is a product of the reaction that produces the surface finish, and the hydrogen gases generated can be easily vented off with usual ventilating equipment, if found objectionable.

Speed of processing is perhaps the chief advantage of the new treatment. Immersion times vary from as few as 15 sec to only 2 min., depending upon the condition of the metal prior to treatment, alloy treated, and dimensional stability required.

Extensive tests to evaluate the performance of the new finish in comparison to the electrolytic treatments are being conducted by many firms. These tests are said to indicate that Iridite #15 at least equals, and in many cases surpasses, the protection afforded by other processes. In all cases, the application method is proving simpler and the total processing time is less.

The finish can be applied to wrought, cast or extruded magnesium and can be used as either a final finish or a base for paint.



This self-locking, spring fastener is vibration-proof, shock absorbent, and easy to insert and remove.

Self-Locking, Spring-Pin Fastener

Standard Pressed Steel Co., Jenkintown, Pa., has announced a new self-locking, spring-pin fastener designed to replace tapered, grooved and dowel pins in all kinds of assemblies. Called Sel-Lok, the pin is vibration-proof, absorbs shock, is easy to insert and remove, and eliminates expensive reaming operations.

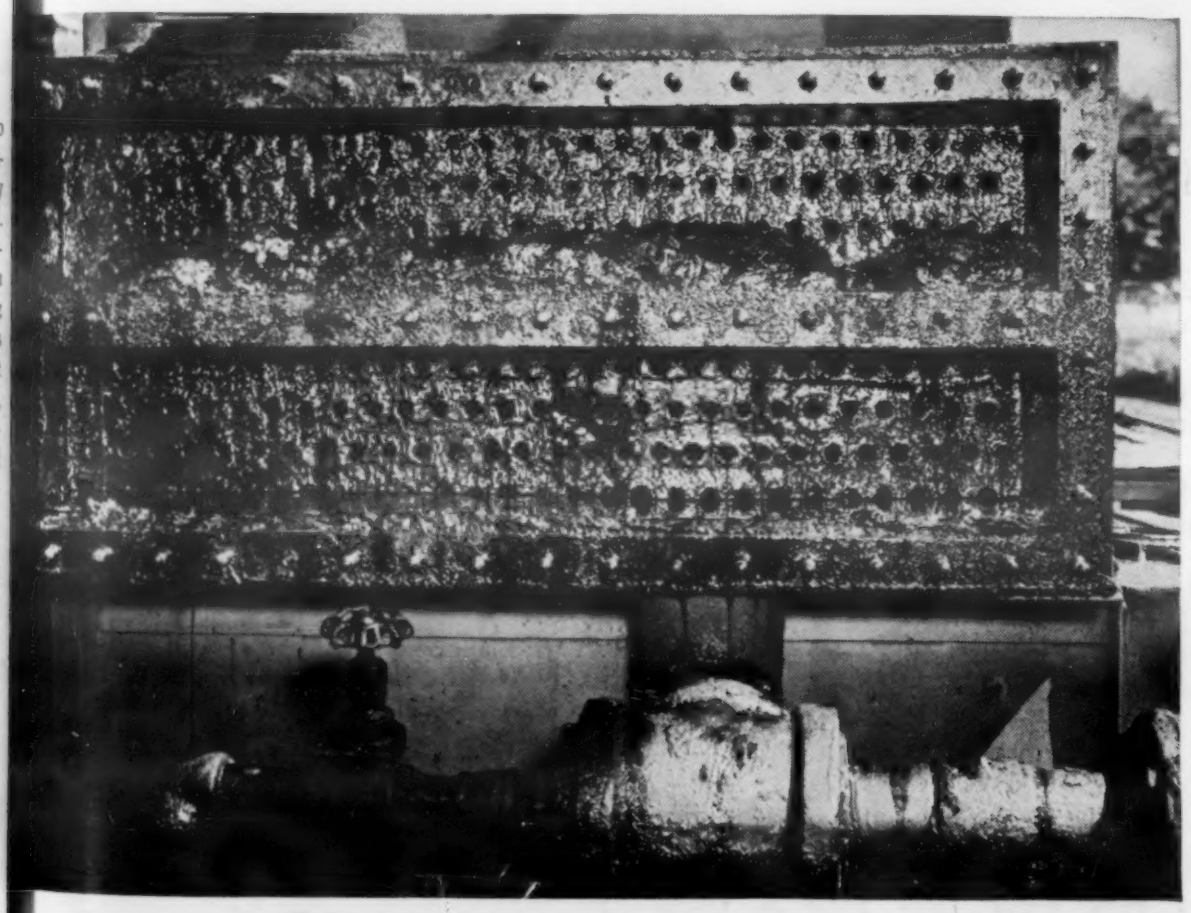
The fastener, which is heat treated, is as strong as a solid cold-rolled steel pin of the same diameter. It is a stock item in standard and light-duty wall thicknesses, in diameters from 1/16 to ½ in., and in a wide variety of lengths.

Pins can be had in carbon steel and in corrosion resistant steel, and, as specials, in copper-based and aluminum-based alloys. Plating available includes zinc and cadmium.

The pins can be used as hinge pins, clevis pins, cotter pins—almost anywhere that two components are to be fastened together.

(*More News on page 223*)

THIS PLANT QUENCHES ALL TYPES and sizes of automotive and aircraft forgings. Sun Quenching Oil Light serves all five of the 2400-3000 gallon systems. In the seven years the shop has been using this oil, no unit has been down except for normal mill scale removal.



AN OIL THAT FORMS SLUDGE CLOGS oil coolers, increases maintenance and operating costs. Sun Quenching Oils have a natural detergency which helps keep the systems clean and removes any deposits that may exist.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

SUNOCO®

PHILADELPHIA 3, PA. ◆ SUN OIL COMPANY LTD., TORONTO & MONTREAL

New Materials and Equipment

Airless Blast Cleaning Barrel Introduced

Pangborn Corp., Hagerstown, Md., has announced a new airless Blastmaster Roto-blast Barrel designed to increase production and lower costs while maintaining high cleaning efficiency.

The two new barrel sizes (3- and 18-cu-ft capacity) 3GN and 18GN, will include all of the eight exclusive construction features which have made the presently available sizes such an instant success. One of the most important of these features is the first really abrasive-tight door ever placed on the market. The door is of all metal construction laminated with a rubber back to protect it from flying abrasive. Its side edges have rollers which travel in a mechanical labyrinth. The door moves up and down like a window curtain, and is easily operated by a crank which winds or unwinds the roller. It is held in any position by a ratchet and brake on the roller. Another feature is a heavy rubber curtain located between the door and the area in which the blasting takes place. This curtain protects the door from flying abrasive and prevents castings from damaging the door. One end of the curtain is attached to the door and the other end to the roof deck. The curtain rolls up and down with the door, weighted by a free metal roller which holds it in position while blasting is taking place.

Another important feature of the barrel is the non-pinch work conveyor, which consists of a continuous hardened steel roller chain with heavy metal slats. The slats are designed so that at no time is any opening presented to pinch the work or clog. Individual perforated slats are easily replaced as they wear, and the entire assembly can be easily removed from the machine.

During barrel operation, the cleaning

Whether your fastener requirements call for special bolts . . . or standard . . . you can get experienced cooperation and service from Buffalo Bolt.

In using Circle Ⓑ specials . . . you can often simplify product design . . . gain extra holding strength . . . speed assembly . . . and cut your unit costs.

In specifying Circle Ⓑ standard bolts . . . you get quality built in by modern methods and machines designed to meet your volume demands.

In both cases, you can depend upon the experienced counsel of a concern which is satisfactorily supplying leading industrials known for their purchasing and production efficiency.

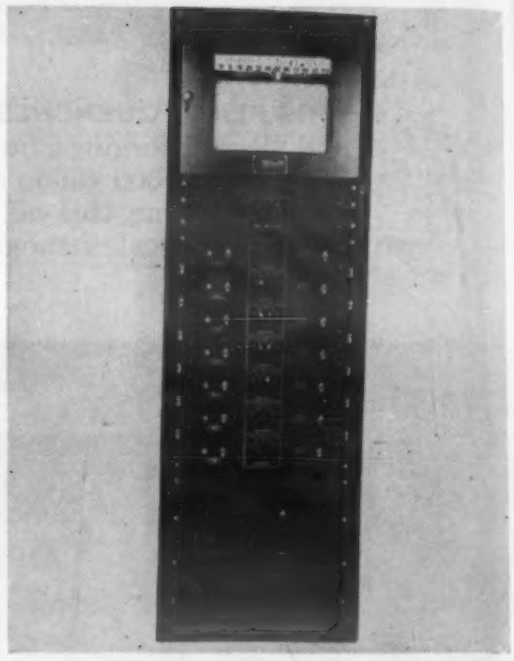
Let us discuss and demonstrate to you the many practical advantages of dealing with Buffalo Bolt. Your inquiry will receive our prompt attention.

BUFFALO
BOLT COMPANY
Division of Buffalo-Eclipse Corporation
North Tonawanda, N. Y.
Sales Offices in Principal Cities
PRODUCERS OF CIRCLE Ⓑ PRODUCTS — BOLTS • NUTS • RIVETS AND SPECIAL FASTENERS

New Materials and Equipment

and reclaiming system is constantly at work removing all sand and debris and maintaining the full efficiency of the abrasive.

The 3GN barrel is powered by two ½-hp and one 1½-hp motors. The 18GN uses two 1½-hp and one 15-hp motors.



Strain-Time Recorders Offered

Accurate and automatic recording of strain in metals can be achieved through the use of a strain-time recorder recently developed by *Gilmore Industries, Inc.*, 5511 Euclid Ave., Cleveland 3. Available in three models, these instruments effect a considerable reduction in the number of man-hours required and in human recording error. They also eliminate the possibility of missing critical changes in creep rate.

Models 108 and 109 are for use with the conventional contact-type (make-brake, follow-up) strain indicators. Six or 12 input channels are furnished which can be operated independently or simultaneously, and the strain values are recorded on a single 11-in. chart, graduated in 100 units. The four ranges available for each channel—0.020, 0.050, 0.100 and 0.250 in.—can be individually controlled.

For short time tests, the recording time can be reduced to 12 sec, or 4½ sec per print. At 4½ sec per print, complete cycles are made in 30 sec for a 6-channel recorder and in 60 sec for a 12-channel recorder. Also available is an additional selector panel to allow operation of all

Bearing Performance Assured

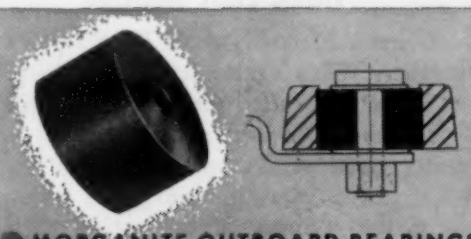
in sealed mechanisms and inaccessible machinery

MORGANITE
SELF-LUBRICATING
CARBON BEARINGS

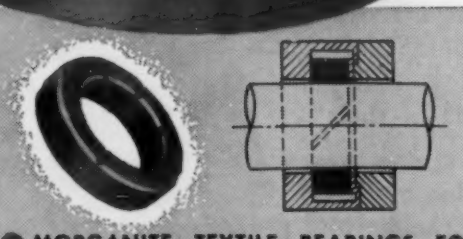
These 6 operating advantages reduce machine downtime, lower maintenance costs and increase production —

1. No lubrication required
2. No maintenance necessary
3. Elimination of cold start drag
4. Resistance to high heat
5. Self-lapping and polishing
6. Unaffected by most acids and corrosion

Durable Morganite Bearings are ideal for installation in inaccessible machines, and for use in hermetically-sealed mechanisms. As their self-lubricating qualities are inherent, and not a result of impregnation, they remain efficient at high temperatures. Because the bearings are self-lapping and polishing, no expensive finishes are necessary.



● **MORGANITE OUTBOARD BEARINGS FOR CONVEYOR ROLLER CHAINS**—Withstand degreasing vapors, dipping bath fumes, high heat, water dip, steam, phosphoric acid spray. Self lubricating under all conditions including extreme changes of atmosphere and temperature.



● **MORGANITE TEXTILE BEARINGS FOR DYE VATS, IMMERSION ROLLS**—Non-contaminating, non-warping, self-lubricating and long-lasting. Remain efficient in all dyes and bleaches with no ill effect to the bearing or the liquid. Will not contaminate chemical solutions.

● **MORGANITE SEAL NOSES FOR CIRCULATING PUMPS**—Self-lubricating, leaktight seals — wet or dry — recommended for all types of pumps. Efficient with all fluids, immune to most corrosive acids and chemicals. For food machinery, fuel pumps, washing machines, automotive and marine engines.

IF YOU HAVE A DIFFICULT BEARING PROBLEM, CONSULT WITH US TODAY —

For complete information on your specific application, write Morganite. Recommendations will be supplied.

Morganite INCORPORATED

Manufacturers of SELF-LUBRICATING CARBON SPECIALTIES, CARBON BRUSHES AND CARBON PILES.

TRADE MARK

LONG ISLAND CITY 1, NEW YORK

The Haller
OIL WELL PRINCIPLE

Now Being Applied To
POWDERED METAL PARTS LIKE THESE

Various types of bearings, bushings, gears, wear plates, machine gibs and other powdered metal parts now incorporate the Haller Oil Well feature.

Originally introduced in bearings, the forming of cavities or "pockets" in the center of powdered metal parts has proved to be a highly successful method of increasing oil content. In such parts, as oil or grease is impregnated into the sintered metal by static pressure, it fills the cavities as well as the pores in the sintered metal body itself. The result is a greatly increased lubricating quality which permits the parts to take heavier loads in their particular applications.

With the many new possibilities for adaptation of this design principle to a wide variety of parts, it can be to your advantage to investigate how it can be applied to your present or future products. The one limiting factor to be considered at the present time is that "oil well" parts are being produced in high volume on a contract basis only. We invite your inquiries.

Write for this bulletin describing our facilities and the scope of our powdered metal parts production.

MICHIGAN POWDERED METAL PRODUCTS COMPANY, INC.

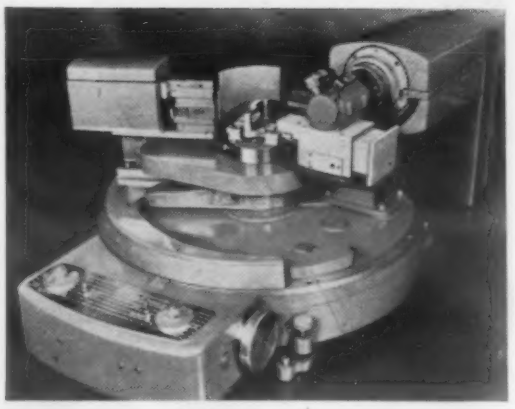
476 CADY STREET • NORTHVILLE, MICH.

Subsidiary of
ALLIED PRODUCTS CORPORATION

New Materials and Equipment

6 or 12 printing records from any one of the single inputs. This panel is useful for short-time tests, in which the 1000-hr tests in progress can be temporarily by-passed or switched out in order to get a maximum reading on a single 1-hr or 2-hr test.

In Model 110, the strain-sensing means is provided by electrical differential transducers for direct attachment to extensometer rods. This model, designed for high temperature tensile testing, records strain values of seven simultaneous tests on a single 11-in. chart, graduated in 100 units. The four ranges of Models 108 and 109 are supplied, in order to obtain a full-scale motion of the recorder for transmitter motions of 0.010, 0.025, 0.050, 0.100 and 0.250 in.



X-Ray Fluorescent Analysis Provides Fast Control

General Electric Co., X-Ray Dept., Milwaukee, Wis., has announced a new piece of equipment called the Fluorescent X-Ray Spectrometer. Based upon the x-ray generator, it is said to make possible somewhat faster determinations, with about 20 times the accuracy of the optical spectrograph. Determinations are not based upon visible emissions from an incandescent specimen, but rather upon the x-ray fluorescence of the specimen when exposed to x-radiation.

The new unit makes use of the radiations emitted by a specimen when placed in an x-ray beam. This radiation is characteristic of each element present, regardless of how combined. The secondary radiation passes through a flat crystal used in the form of a thin strip of mica which serves as a diffraction grating. This analyzing crystal is rotated and automatically curved to focus this secondary radiation upon a Geiger counter, where the num-

Digging for buried treasure

In the search for faster, better ways of digging out the earth's many mineral treasures, designers of mining machines and equipment are finding OSTUCO Tubing the ideal solution to countless problems.

Drill posts, augers, conveyors, roof jacks, seam cutters, elevators, fans, power shovels, and draglines are but a few of the items that can be and are being improved by OSTUCO Tubing in the form of bits, shafts, rolls, supports, hydraulic and air cylinders, weldments, bushings, sleeves, spacers, handles, bearings and the like. Strength, rigidity, light weight, unlimited design flexibility and low cost are some of the reasons why engineers in this industry, as in practically every field, specify OSTUCO Seamless or Electric Welded Steel Tubing. They know they can count on OSTUCO for consistent highest quality, and they like the convenience of OSTUCO's Single Source Service, made possible by manufacturing, forging and fabricating all at one plant.

It will pay you to consult our experienced engineers about OSTUCO Tubing for your current needs or for redesigning your products to meet future competition.

From Your Blueprint . . . to Your Product
OSTUCO TUBING
Tapering • Swaging • Flanging • Bending
Upsetting • Expanding • Reducing • Beading
End closing • Spinning • Drilling • Slotting
Notching • Flattening • Shaping • Trimming
Threading • Angle Cutting • And Many Others

THE OHIO SEAMLESS TUBE COMPANY

Manufacturers and Fabricators of Seamless and Electric Welded Steel Tubing

Plant and General Offices: SHELBY, OHIO

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ACCO products

WILSON "Rockwell"* Hardness Testers

NOW FOR ONLY

$550

(less accessories, F. O. B. Bridgeport)

you can get this

J-MODEL WILSON "Rockwell"

The Best...Costs Less...to Use

• When you use WILSON "*Rockwell*" Hardness Testers to check your products during various stages of manufacture, you will *be sure*. You will prevent costly complaints from your customers. The long experience of WILSON'S Standardizing Laboratory engineers is your assurance of top quality and accuracy in the "*Rockwell*" Testers you buy.

Six Important Features

1 Totally enclosed, dirt and dust-proof "Zerominder" dial gauge
2 Gripsel clamp screw for quick change and proper seating of penetrator
3 All controls grouped conveniently
4 Enclosed, easy-to-reach variable speed dash pot
5 Stainless steel elevating screw
6 Standardized weights

WILSON Makes a Complete Line

There are two types of WILSON "*Rockwell*" Hardness Testers ... Regular and Superficial. They come in many styles with accessories for testing flats, rods, rounds, and odd shapes. For micro-indentation hardness testing, there is the WILSON TUKON.

Write for information and let us make recommendations

*Trade Mark Registered

ACCO

WILSON MECHANICAL INSTRUMENT DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

230-E Park Avenue, New York 17, N. Y.

WILSON "ROCKWELL" and TUKON Hardness Testers

New Materials and Equipment

ber of impulses are counted. The wave lengths of the K-radiation and the L-radiation for each element have been tabulated, so that a peaking of impulses in the Geiger counter at the wave length corresponding to a given element indicates the presence of that element. By totalling the number of impulses the determination can be made quantitative.

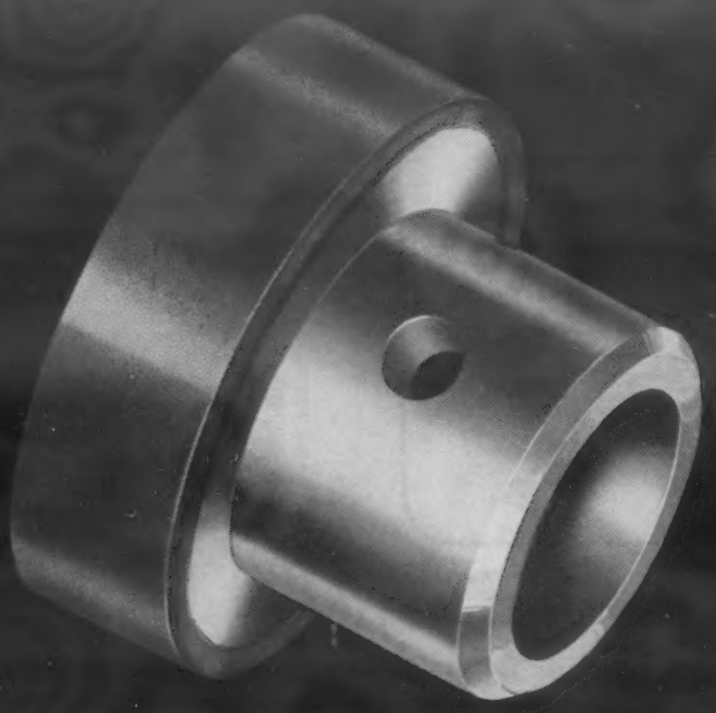
The peaking of the impulses in the Geiger counter is quite sharp. While the qualitative determination is made by simple noting of the wave length at which peaking occurs, the quantitative determination is more complicated. A totalizing or scaler mechanism records the total impulses in counts per second. This total is affected by the other materials present in an alloy or other material of mixed composition, so that an accurate quantitative determination can be made only by making determinations with known materials approximating the composition of the unknown. The proper adjustments can then be made in the results from the unknown alloy. This is not as great a difficulty as might be imagined, however, as the brasses from a brass foundry, for example, will have the same principal ingredients, and essentially the same standardization curves.

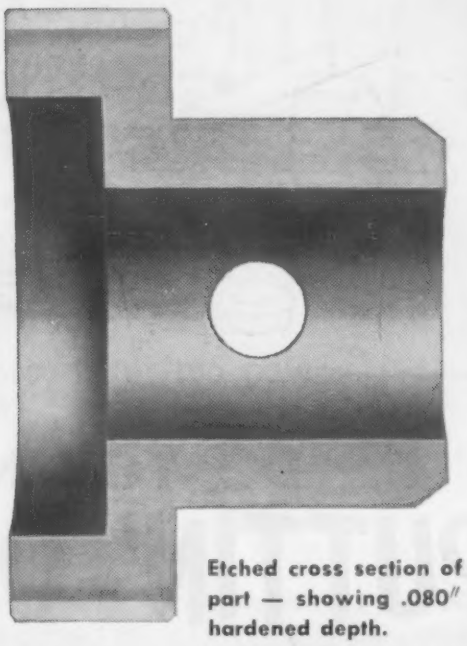
At present the apparatus is suitable only for determinations upon elements having an atomic number above 22. This excludes silicon, magnesium, aluminum and beryllium, among others. It might be possible to include some of these elements in the range of the instrument if the path of the beam and sample could be enclosed so as to operate in a vacuum, but the absorption of the Geiger tube window will limit the number of additional impulses which can be analyzed even with a vacuum chamber. The K-alpha and K-beta radiations are used for elements of atomic number from 22 to about 60, where the tabulation begins use of the L-radiation.

The method is nondestructive. Only secondary radiation from the surface of the specimen is used.

A large naval installation in the East is currently using the equipment to determine the composition of many types of bronzes. It has been used to determine composition of porcelains, enamels and similar materials after they have been fabricated or applied to a base material. An obvious possibility is in the determining of elements and percentages in alloys being melted in foundries, for which determination a test bar is used. In addition, it is being used for studies of plating thickness, for extent of diffusion of one metal into another, and for extent of oxidation of a metal. An important use, just beginning to be realized, is the possibility

COSTS CUT 94%





Etched cross section of part — showing .080″ hardened depth.

with TOCCO* Induction Heating

A cost reduction of 94% resulted when heat-treatment of this Corn Harvester part was changed from carburizing to TOCCO-hardening. Look at the unit cost breakdown:

CARBURIZING		TOCCO-Hardening	
Degrease	$0.0020	*eliminated*	
Carburize	0.0200	*eliminated*	
1st quench	0.0150	TOCCO, heat and quench	$0.0060
2nd quench	0.0150	*eliminated*	
Draw	0.0050	*eliminated (self-draw)*	
Shotblast	0.0035	*eliminated*	
Internal Grind	0.0243	*eliminated*	
External Grind	0.0166	*eliminated*	
	$0.1014		$0.0060

"—Savings of 9½ cents per piece—$4770.00 on each 50,000 piece batch, *plus* an hourly production increase from 120 to 300 pieces per hour, *plus* improved quality of the product by virtue of the deeper case and stronger core."

Have you investigated TOCCO's cost-savings possibilities for your hardening, brazing, melting or forging operations? Why not write us today or send blueprints of your parts —no obligation, of course.

THE OHIO CRANKSHAFT COMPANY

TOCCO

*Trade Mark Reg. U.S. Pat. Off.

Mail Coupon Today

NEW FREE BULLETIN

THE OHIO CRANKSHAFT CO.
Dept. T-6, Cleveland 1, Ohio

Please send copy of "A TOCCO Plant Survey—Your Profit Possibility for 1953".

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Company _____

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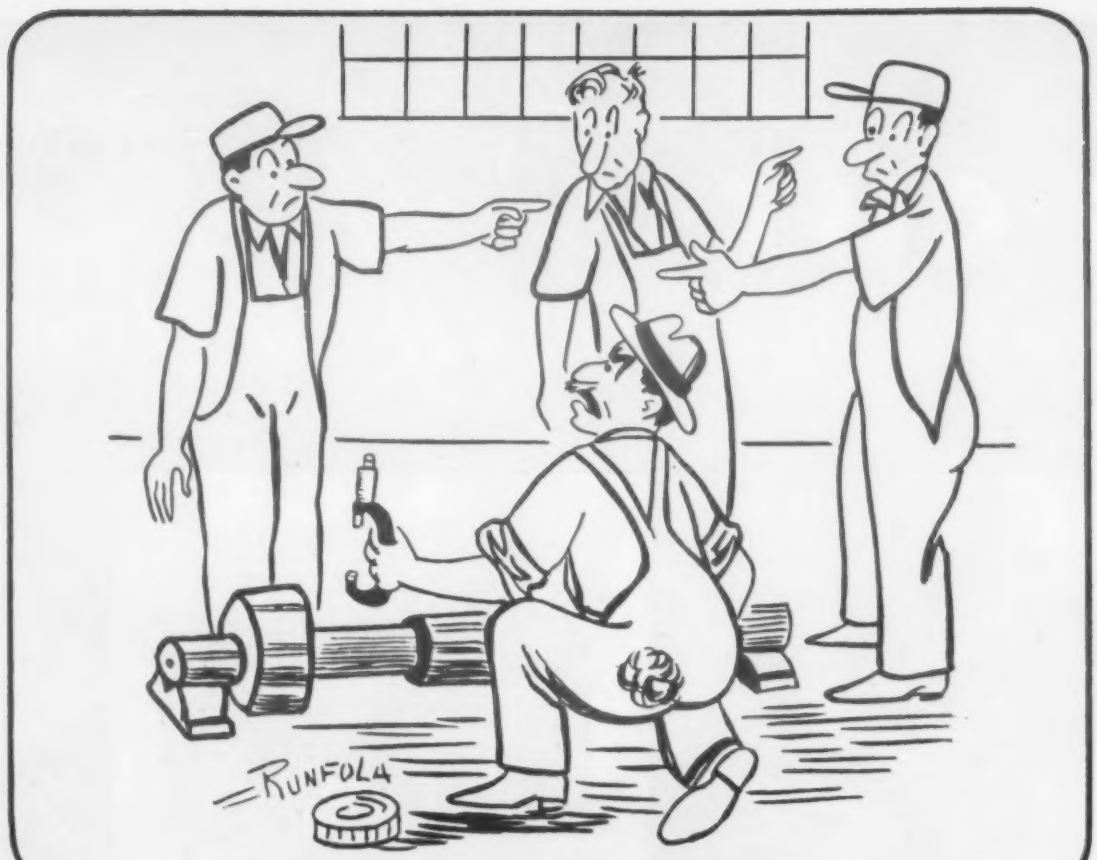

"WHO CUT THIS 0.0006" UNDERSIZE?"

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DO YOU NEED A "PUTTIN'-ON-TOOL"

for salvaging undersize parts, worn tools and gages right in your own plant?

Now, with the Chromaster industrial chrome plating unit, you can restore undersize components or worn tools to exact dimensions, easily and simply, in a matter of minutes. With Chromaster, you will be able to salvage thousands of dollars worth of material you're now throwing into the scrap bin.

Here are the facts about Chromaster:

- **SIMPLE TO OPERATE**
- **NO PREVIOUS PLATING EXPERIENCE NEEDED**
- **FAST DEPOSIT RATE. .002" per hour**
- **CHEMICALLY STABLE PLATING SOLUTION**
- **LOW PLATING COST . . . only 7 mils per sq. in. .002" thick**

Now take a look at a few of the actual savings the Chromaster has made in other plants.

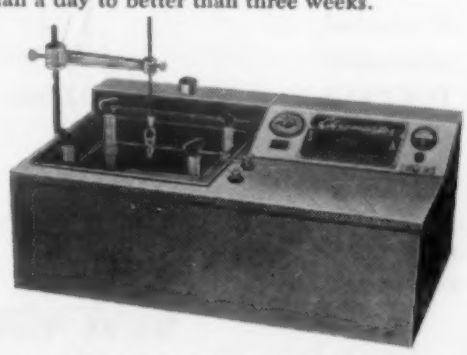
ACTUAL CHROMASTER SAVINGS

A CHICAGO TOOL COMPANY with 1500 shafts ground undersize used a Chromaster to return them to their original size with a surface finish of greater wear resistance.

A PHILADELPHIA MANUFACTURER used Chromaster to correct an oversized cylinder bore by plating to size.

A BROOKLYN FOUNDRY saved two grinding operations and almost five hours in plating time on every component with Chromaster.

A CALIFORNIA AIRCRAFT FACTORY salvaged expensive worn-down reamers with Chromaster. The new plating increased their useful life from less than a day to better than three weeks.



A CHROMASTER FOR EVERY SHOP

Model A-20 is a 20-amp, bench-mounted unit for the gage room or tool crib; plates up to 10 sq. in.

Model A-50, 50-amp, bench-mounted unit for larger shops in plating of cutting tools. Plates up to 25 sq. in.

Model A-250, 250-amp, floor-mounted unit for production plating of small parts in greater quantities or larger parts with areas up to 125 sq. in.

Chromaster

Write for money-saving free information today A•3•3

Industrial Chrome Division
Ward Leonard Electric Co.
16 South Street,
Mount Vernon, N. Y.

Please send me information on industrial chrome plating with CHROMASTER.

COMPANY.....

NAME..... TITLE.....

ADDRESS.....

CITY..... ZONE..... STATE.....

New Materials and Equipment

of determining the presence of metals, even in small amounts, for which chemical techniques are not yet well established, as for example, hafnium.

Electric Furnace for Maintenance and Small Parts Production

A small electric furnace designed for maintenance and small parts production has been announced by *Armor-Tuf Sales Corp.*, 299 Madison Ave., New York. The furnace was designed primarily for use in the hardening of tools and steel parts with Armor-Tuf, the steel hardening compound made by the company, but the unit has many other applications.

Heat treating, enameling, chemical drying, wax burnout, and other uses can be found for the unit in the laboratory as well as in maintenance and production.

The furnace is said to easily attain a temperature of 1800 F from an ordinary wall socket line of 110 to 120 a.c. The inside dimensions are 4⅜ in. deep by 4 in. high by 9 in. wide. It is fully automatic and built for hard usage.

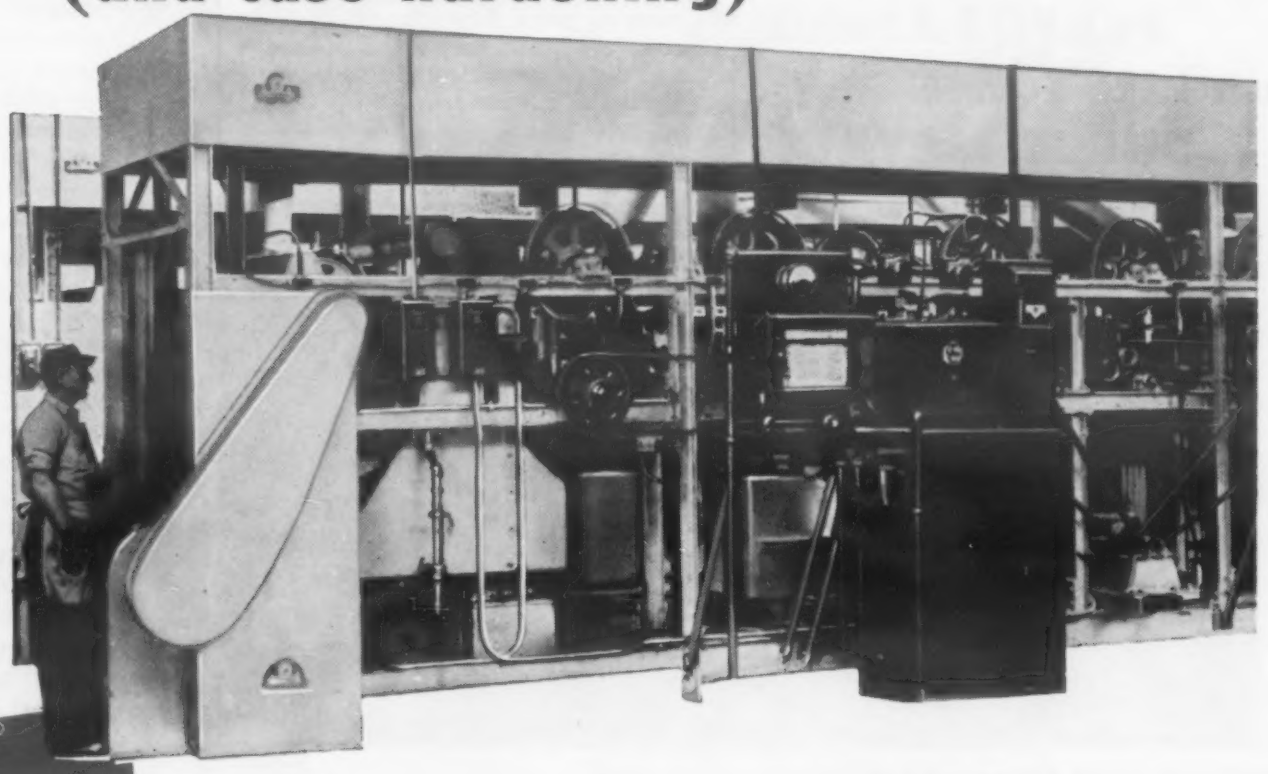
Improved Flux for Use in Silver Brazing

An improved, all-purpose version of its 1200 flux compound has been announced by *The American Platinum Works*, Newark 5, N. J., for use in silver

CUT COSTS WITH THE

Fastest Carburizing

(and case hardening)



Labor Cost Reduced 80%

...by these two mechanized lines using Ajax Salt Baths for carburizing compressor parts in plant of prominent manufacturer of electric refrigerators.

More economical . . . is the fastest method of producing a specified case depth—for example, a case of 0.040 in. can readily be produced in 2 hours . . . No boxes or retorts to pack and unpack or to heat as dead loads.

Less distortion . . . temperature uniformity throughout bath guaranteed within 5°F. . . . less subsequent grinding . . . permits more shallow case depths.

Closer control of depth and other properties of the case.

Selective carburizing simplified by immersing only portions of work to be treated.

Eliminates usual reheating operation . . . work quenched directly from carburizing bath.

Extreme flexibility . . . several batches may be case hardened simultaneously—each to a different case depth.

No "oxygenation" of the case, with attendant pitting and spalling, as frequently occurs in gas or pack carburizing.

Readily adaptable to mechanization for efficient, low-cost mass production.

Combines with martempering . . . for best control of distortion . . . by an isothermal salt bath quench directly after carburizing.

Brazing can be performed simultaneously . . . both carburizing and brazing done with one heating of the work. Brazing cost—nothing.

Low maintenance costs . . . plain steel pots have a life of 1 to 3 years.

390 Lbs. of Work an Hour

. . . from an Ajax furnace no larger than your desk!

180 lbs. of metal body screws per charge are case hardened (0.004" to 0.010") as required.

AJAX ELECTRIC COMPANY, INC.

906 FRANKFORD AVENUE, PHILADELPHIA 23, PA.

World's largest manufacturer of electric heat treating furnaces exclusively

Associate Companies: Ajax Electric Furnace Corp. • Ajax Engineering Corp. • Ajax Electrothermic Corp.

AJAX ELECTRIC SALT BATH FURNACES

SELF-HEATING • SELF-CIRCULATING

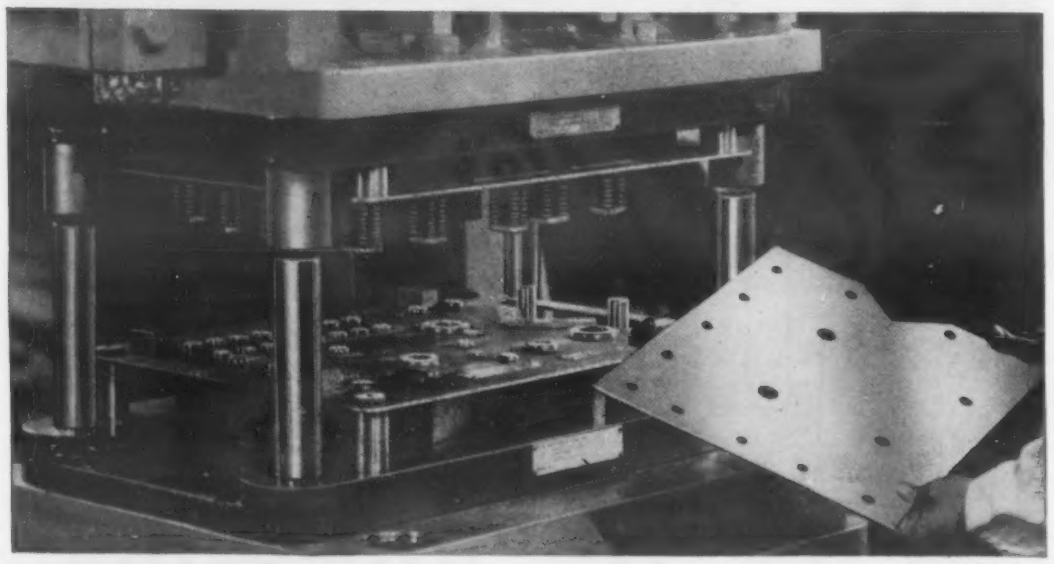
New • Fast • Proven

LOW COST

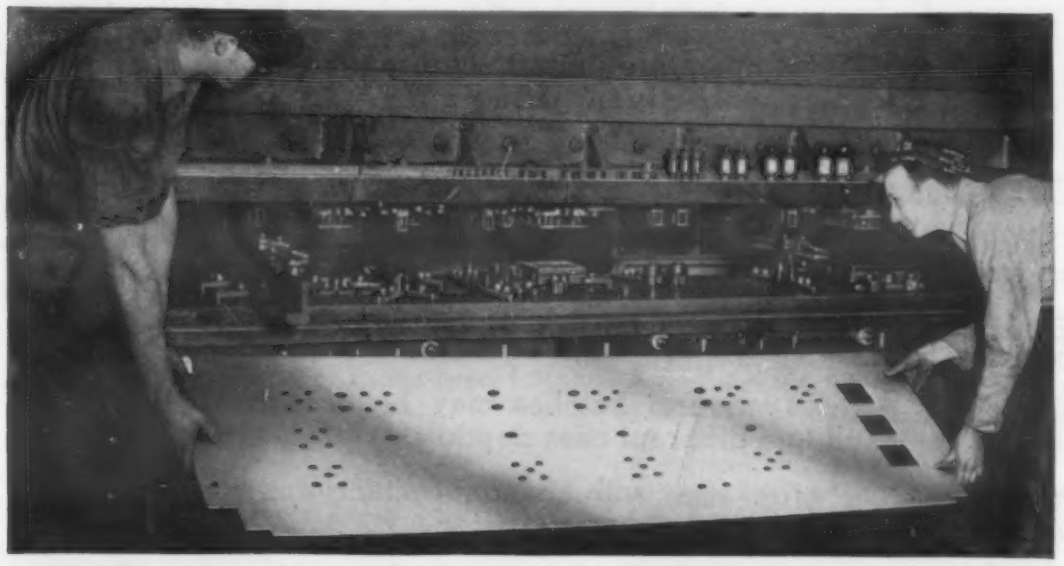
methods for PERFORATING and NOTCHING SHEET METALS

REDUCE DIE COSTS

All units and parts are interchangeable and used repeatedly in different arrangements. **INCREASE PRESS PRODUCTION**–*Down time is minutes as compared to hours for changeover.* For precision work in all types and sizes of presses. **START PRODUCTION AT ONCE.** Pierce materials up to ¼" thick mild steel. Standard sizes and shapes available up to 3 inches. Special sizes to order.



Whistler *MAGNETIC* Dies at work in large inclinable press. Magnetized retainers hold the units. No bolting required. A fast, economical method in making up a punch and die set for short or long runs. All parts re-usable.



Whistler *ADJUSTABLE* Dies on perforating and notching job, using Tee slotted die set. With Whistler Adjustable Punch and Die units production starts within hours instead of weeks. Last minute job changes made quickly.

● Here are the complete details with prices and application illustrations. Send for these catalogs. No obligation.

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Adjustable, Magnetic, Custom and Cam Dies for all Industry

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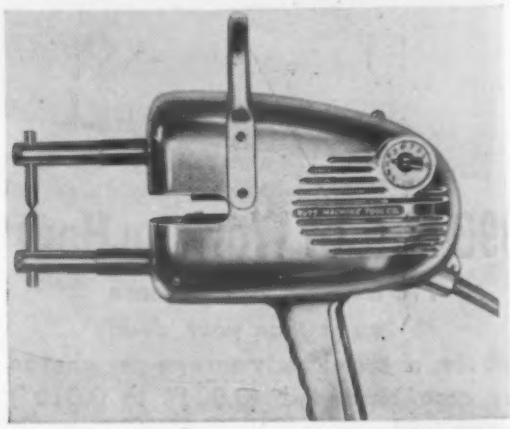
New Materials and Equipment

brazing operations. The product, which retains the same 1200 brand name, is designed for universal application with silver solders in the brazing of ferrous and nonferrous metals. Noting that it possesses superior cleansing and protective properties, the company also emphasizes that it can be used on all metals, at all temperatures common to silver brazing.

Consisting of a mixture of fluoride and borate salts, the flux melts at a temperature lower than the alloys employed and forms a coating of fused salts over the brazing area. It performs three functions: covers the work and the brazing alloy, preventing oxidation of the surface during heating, brazing and cooling; cleans and floats off dirt or oxides; and reduces surface tension of the molten alloy, causing it to flow freely over work surfaces that have been heated to brazing temperature. A smooth paste, it is easily removed after brazing by washing with water, the company reports.



Electronic Time-Controlled Portable Spot Welder

A portable spot welder with built-in thyrotron controlled timer switch is now being marketed by *Ross Machine Tool Co.*, 7631 S. Ashland Ave., Chicago 20. Any timing cycle from 1/60th sec to a full second can be established by switch setting. All electronic controls and a transformer suspended for quick heat dissipation are contained in the aluminum housing, yet the weight is only 26 lb.

It is said that this is the first portable tool that will weld most alloys of aluminum sheets as well as mild, stainless, galvanized and cadmium plated steel and other metals, to a 3/16-in. combined thickness. Perfectly timed welds are made as fast as the operator can squeeze the pistol grip. The welder operates from

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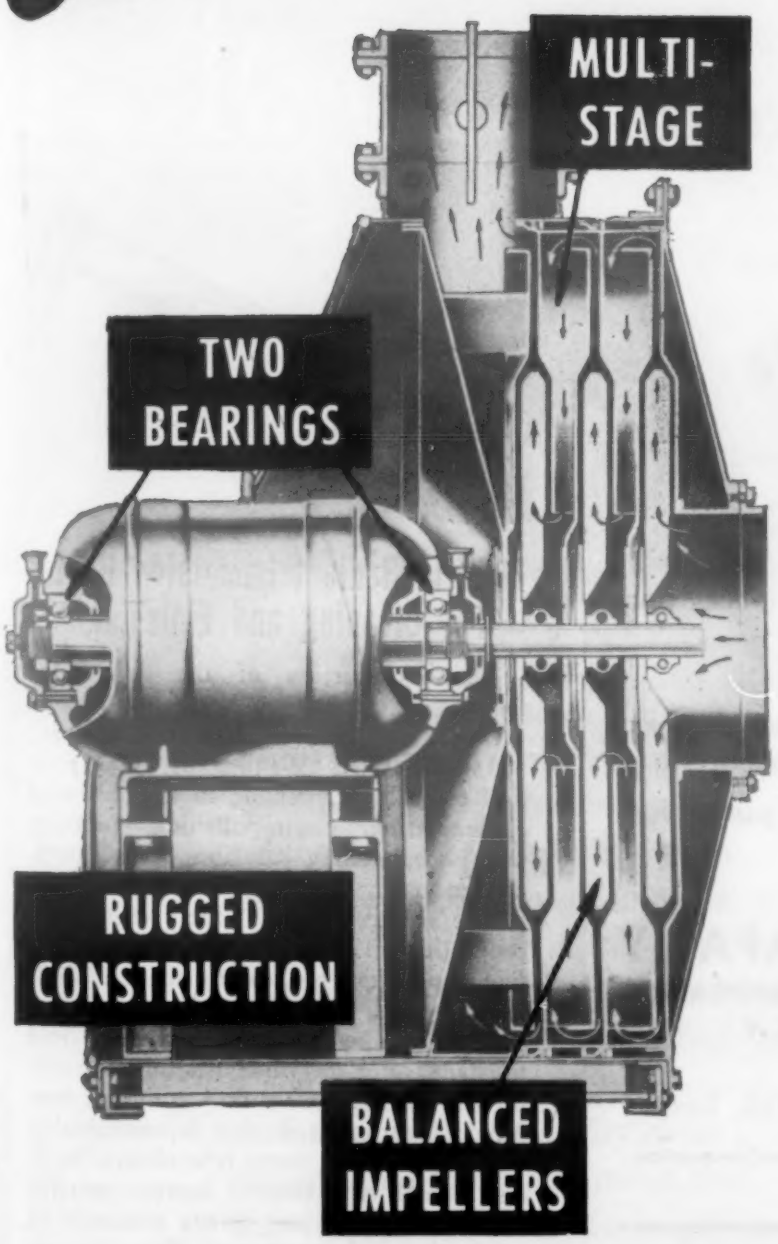

There are good reasons why the annual installation of Spencer Turbos has increased tenfold in ten years and why a recent analysis shows that repair parts amount to less than one dollar per machine per year.

No. 1. The Spencer multi-stage construction allows a smaller diameter machine with lower peripheral speeds of the fan blades and of the motor itself. The wear on the bearings is therefore cut to a minimum.

No. 2. The only rotating contacts are at the two ball bearings, which if kept greased will assure satisfactory operation without work stoppages for many years.

No. 3. Here is a machine as simple as an electric fan, with a rugged construction, as sturdy as a steel bridge and with wide clearances between the rotating elements and stationary parts. Users say "the Spencer goes on forever with little attention."

No. 4. Balanced Impellers. Each fan is individually balanced before the machine is assembled. This decreases the vibration, increases the life of the bearings and packing and produces quiet performance.

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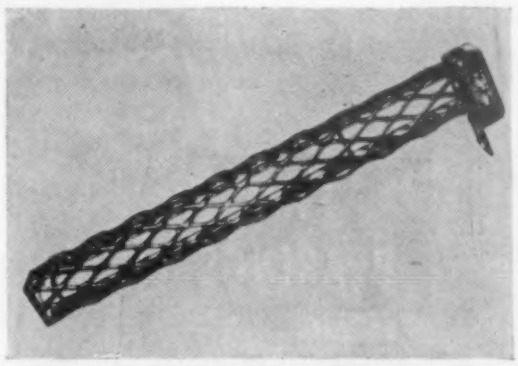
220 to 240 v, 60-cycle a.c., and develops electrode pressure to 1000 lb and amperage over 12000 at point of weld. Standard model has 7-in. throat depth and 3-in. opening. Additional throat depths up to 18 in. and special shaped arms and tips are available.

A mounting stand which converts the portable unit to a foot-operated floor model for semi-production work, and adapters for quick changeover to water cooling are also offered.



Electric Radiant Immersion Heater For Cleaning and Finishing

The introduction of the new Glo-Quartz Electric Radiant Immersion Heater (*Glo-Quartz Electric Heater Co., Inc.*, 37934 Elm St., Willoughby, Ohio) is said to make it possible to heat all acid electroplating, electropolishing, pickling and phosphatizing solutions with 100% efficiency.

The heaters utilize the outstanding properties of fused quartz for the scientific application of heat to all acid solutions regardless of concentration or temperature. The smooth, surfaced, acid resistant, non-metallic heating sheaths used in the heaters are said to offer a new way of heating acids that is unattainable with conventional metal type electric heaters. Metal type electric heaters transfer heat to liquids by the slower processes of conduction and convection. These immersion heaters transfer heat to acid solutions instantly by radiation. The heating element placed inside the heaters provides an excellent source of far infra-red heat waves which readily pass through the fused quartz sheath, thus heating the liquid efficiently and economically. The sheath temperature is only a few degrees higher than the liquid, thus eliminating the possibility of rock-like deposits from forming on the surface of the heater. No deposits can form on the heater surface;

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You're right from start to finish with Rockrite. Whether you use Rockrite cylinder finish steel tubing for hydraulic cylinders, shock absorbers or similar parts, you'll find there's nothing quite like Rockrite. The inside is smooth, free of surface defects—a surface that's perfect for a piston with soft packing. Smooth bore surface plus exceptionally close dimensional tolerances mean that this tubing can be cut to length and used as is. You can also make standard, interchangeable parts.

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New Materials and Equipment

therefore, no ingredients are taken out of the pickling or plating solution, thus reducing plating costs and increasing plating quality.

Two types of heaters are available; type GN heaters have a ground lead and a vapor-proof conduit box with a non-replaceable heating element. Type FR heaters have cartridge type, renewable fuses inside an explosion-proof, vapor-proof conduit box for maximum protection of personnel and equipment. The heating element can be replaced when worn out without removing the heater from the tank. Automatic temperature control equipment can be used with both types.

Electronic Insulating Polystyrene Plastics Introduced

A flexible oriented plastic film is now being produced from polystyrene by *Natvar Corp.*, Woodbridge, N. J., under the trade name Styroflex. The film does not exhibit any of the brittle characteristics of other forms of polystyrene; it has, however, the same excellent basic electrical properties that have made polystyrene one of the most widely accepted high frequency insulating materials.

Originally made in Germany, the material's development was accelerated during World War II to meet the need for special insulating materials for military uses requiring both high performance and miniaturization. It is now made in the United States under license agreement. The film now produced here has benefited from recent improvement in the heat resistance of polystyrene, and has a wider normal working range. It resists great pressures without yielding at temperature below the softening point of 95 C, and shows almost no plastic flow.

The great compressive strength, approximately 14,000 psi, and high tensile strength, 10,000 psi, combined with its low elongation, make it a very desirable flexible insulation, especially suitable for many new high frequency applications. It is a nonhygroscopic material. Since no moisture film forms on its surface, it is unaffected by adverse humidity conditions.

One of the most promising developments is the Styroflex insulated coaxial cable manufactured by Phelps Dodge Copper Products Corp. Another interesting use is in low loss capacitors. It makes possible wound type capacitors having

PERMANENT FLEXIBLE SEALS

with Thiokol*

LIQUID POLYMER LP-2

A pourable liquid that converts to a rubber at room temperature *without shrinkage*

Compounded and cured, "Thiokol" LP-2 displays the following characteristics:

- **EXCELLENT BOND STRENGTH**
- **TOUGHNESS AND RESILIENCE**
- **WATER, OIL AND SOLVENT RESISTANCE**
- **BROAD SERVICE TEMPERATURE RANGE**
- **OZONE, SUNLIGHT, AGING RESISTANCE**

The sealer shown here is made by Minnesota Mining and Manufacturing Co. Thiokol Corporation supplies LP-2 only as a raw material. Because of its desirable properties, "Thiokol" LP-2 was selected as the elastomer for this particular sealer.

The application shown here illustrates how two parts of a plastic washing machine agitator are bonded together with a sealer based on "Thiokol" LIQUID POLYMER LP-2. A permanent flexible seal unaffected by changes in temperature or water erosion is obtained.

Sealers and adhesives based on "Thiokol" LP-2 simplify many processes because they can be flowed into place and cured at room temperature. They form tough, resilient bonds with glass, metals, plastics, synthetic rubber, wood, leather.

This application is only one of many in which "Thiokol" LP-2 simplifies a process and yields desirable product characteristics. It may yield similar advantages in your product or process.

Our technical personnel will gladly discuss the suitability of "Thiokol" LP-2 for any application you have in mind.

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CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

New Materials and Equipment

accuracy and efficiency characteristics comparable with the best mica units, at much lower cost. The high surface and volume resistivity indicate that a condenser having a polystyrene film dielectric can hold its charge indefinitely. This should reduce the cost and increase the efficiency of many intricate electronic devices for military and civilian use.

All-Purpose Black Light Inspection Unit

A new, high-intensity, long wave light designed for use as a portable black light inspection lamp in scientific laboratories, and for industrial and agricultural inspection, has been announced by *Ultra-Violet Products, Inc.*, 145 Pasadena Ave., South Pasadena, Calif.

Model B-50-H Mineralight is an intense 100-watt long wave ultra-violet hand lamp operating on 110-v a.c. current. It throws a powerful directional beam of long wave (3660 A.U.) ultra-violet up to 30 ft away. It will clamp rigidly to its non-tip base (containing transformer) and can be permanently locked to any desired position.

The unit is useful in detecting oil leaks in machinery or on fabrics because under activation by ultra-violet the slightest trace emits a bright glow. In addition, the B-50-H in combination with invisible fluorescent inks, dyes or powders, can be used for valuable industrial or laboratory inspection operations, for the determination of flaws, adulteration, decay or con-

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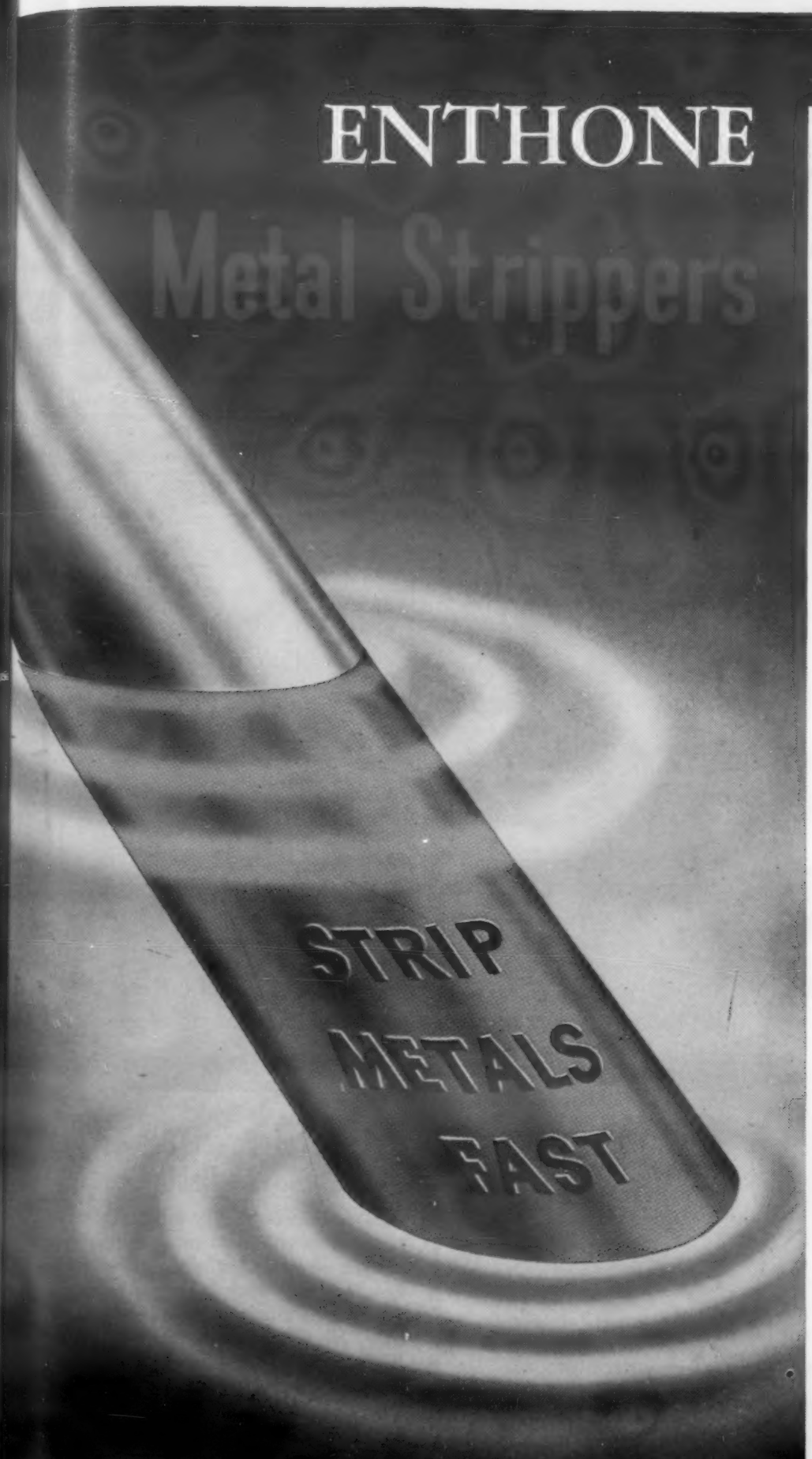

METAL STRIPPER "A"

An alkaline stripper that dissolves nickel, copper, zinc, cadmium and silver without attack on steel or stainless steel.

METAL STRIPPER N-165S

Used in acid solutions to strip nickel, zinc, iron, cadmium, lead and tin without attacking basis metals of copper, brass, silver and gold.

TIN-LEAD STRIPPER

Dissolves tin, lead and solder from basis metals of copper, brass, steel, stainless steel, nickel, silver and gold. Alkaline in nature.

ZINC STRIPPER

An alkaline stripper for fast stripping of zinc from steel and copper.

ZINC DIE CAST STRIPPER

Compound L-88, an electrolytic acid stripper to strip chromium, nickel, copper and brass from zinc base die castings without pitting the basis metal.

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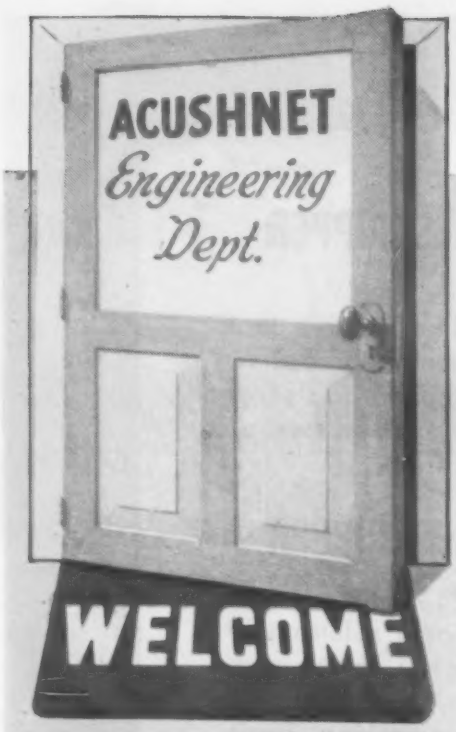

At all times our Engineering Staff welcomes the opportunity of working with you on the design, development, improvement or production of "precision" molded rubber parts.

Whether the required part is complex in design or must overcome problem conditions involving fluids, gases, friction, flexing, high or low temperatures, we are confident the specialized knowledge of our engineers can produce the right answer — the first time!

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New Materials and Equipment

tamination, and for the detection of improper coverage of protective coatings. Many substances, like oil and various types of decay bacteria, fluoresce naturally without additives.

Improved Power Bender Now Available

Redesign of their hydraulically operated bending machines to more evenly distribute the stress and strain developed during bending and also keep mechanical distortion to a minimum, has been announced by *O'Neil-Irwin Manufacturing Co.*, 568 Eighth Ave., Lake City, Minn. According to the company, changing the design of the bending table from fabricated steel to a strongly-ribbed alloy casting provides greater strength during bending and allows the integration of the gear housing into the casting, assuring positive alignment at all times.

Further improvements are:

1. Addition of foot controls as well as hand controls, which free the operator's hands for material handling and work positioning.
2. Replacement of a 2-h.p. motor with a 3-h.p. motor.
3. Use of ¼- to ½-in. steel plate instead of sheet fabrication on the cabinet, which results in improved rigidity.

The Di-Acro power bender is an all-purpose machine which can be used for forming simple and complex bends in round stock, tubing, angle, channel, mold-

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When you place an order for alloy steel plates with Claymont you get the benefit of close-knit, coordinated teamwork that assures painstaking supervision on every order, large or small.

Right down the line, starting with our front office, your order gets personalized attention from our engineers, metallurgists, laboratory analysts, and skilled workers who make your steel and roll your plates.

You'll find it's good business to entrust your specialized needs in alloy steel plates to Claymont. That way, you're always sure of plates that are truly tailored to your individual requirements.

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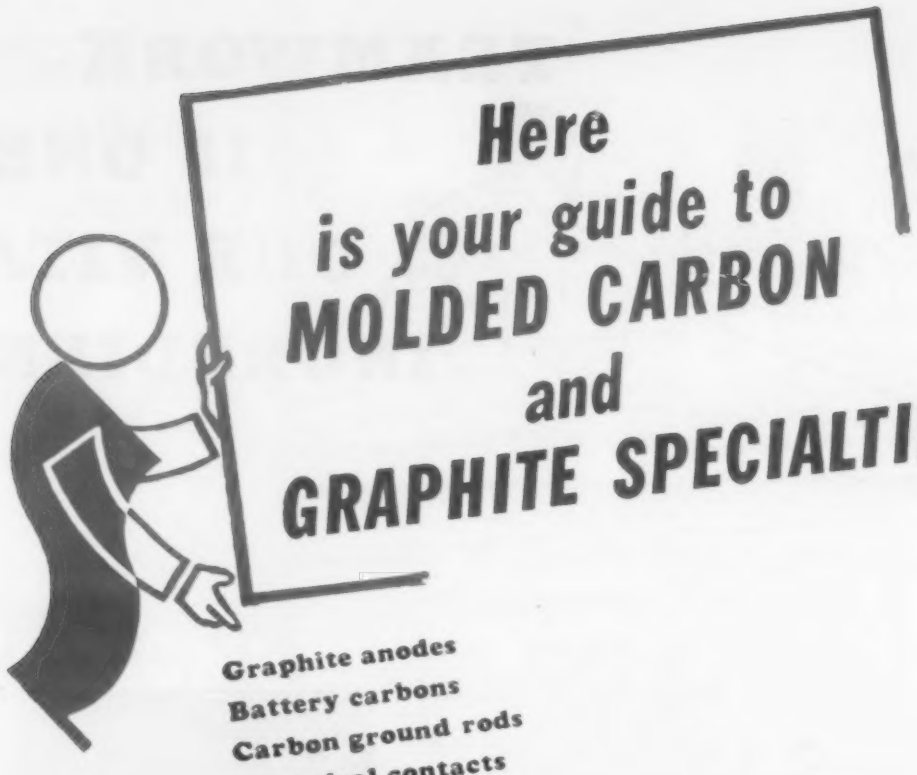

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Battery carbons
Carbon ground rods
Electrical contacts
Carbon piles
Chemical carbons
Trolley and pantograph shoes
Water heater and pasteurization electrodes
Seal rings
Friction segments
Clutch rings
Bearings
Brazing furnace boats
Electric furnace elements
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"EVERYTHING IN CARBON BUT DIAMONDS"
STACKPOLE CARBON COMPANY
St. Marys, Pa.

New Materials and Equipment

ing, strip stock, extrusions, and many other ductile materials. It is possible to bend in either a clockwise or counterclockwise direction by making a few simple adjustments.

General Purpose Phenolic Thermosetting Compound

A new general purpose phenolic thermosetting compound in black or brown has been announced by the Chemical Div., *Borden Co.*, 5000 Summerdale Ave., Philadelphia 24. The compound has versatile molding characteristics as well as superior machining qualities, high surface luster and mechanical strength.

Marketed as Durite GP-151, the new product is said to combine excellent drilling and tapping characteristics, a wide range of flows, and good buffing qualities. The company also reports it is an extremely fast curing material with excellent appearance in all flow ranges.

Automatic Washing Units Speed Metal Cleaning

A new line of compact, forced-circulation washers in three different sizes, designed to speed metal cleaning through automatic cycling and by combining washing and rinsing in one operation, has been announced by *Ipsen Industries, Inc.*, 715 S. Main St., Rockford, Ill. The single stage units are said to completely eliminate secondary washing and extra work handling operations by employing an automatic surface spray skim-off. When used with recommended detergent and

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When Driver-Harris introduced Nichrome* in 1908, *dependable* electric heat became possible for the first time. And with each passing year, Nichrome looms larger as the *ideal* alloy for producing electric heat in domestic and industrial equipment.

Its consistent dependability and unique performance have earned it a world-wide reputation—and made it *the* standard of quality for electrical alloys. That's why today, the great majority of heating elements of all types—in applications ranging from electrical home appliances to large industrial furnaces—are made of this excellent alloy.

Naturally, we take particular pride in our trademark: Nichrome—granted solely and wholly to us by the United States Patent Office forty-five years ago. Representing a series of superb heating and resistance alloys, developed and produced *only* by Driver-Harris, this trademark symbolizes *long life* and *trouble-free* operation to manufacturers everywhere.

Sole producer of Nichrome®, Advance®, Karma® and over 80 other alloys for the electrical, electronic and heat-treating industries.

*T.M. Registered in United States Patent Office by Driver-Harris Company August, 1908

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New Materials and Equipment

surfactant compounds, metallurgically clean results are accomplished over 50% faster than with ordinary washing methods. For average load conditions, a total cycle of 5 to 7 min. is sufficient to thoroughly clean work pieces.

Solution temperatures, work handling, and cycles for solution circulation and skim-off are all controlled automatically by pre-settings on a panel conveniently located on the front of the washer. Because of work handling efficiency and washing speed, the units are especially adapted to line operation as well as a wide variety of standard degreasing and oil removal applications.

The compact welded steel units are available in load capacities of 300, 400 and 700 lb. Load platforms are swivel-type roller units, and can be attached to either end of the washer for in-and-out operations, or to both ends for straight-through operation. Platforms have solid pans to catch drippings.

Rust-Inhibiting Metal Cleaning Compound

Development of Powrite, a new rust-inhibiting metal cleaning compound, has been announced by *Whitfield Chemical Co., Dept.* 16-A, 14225 Schaefer Highway, Detroit 27. The product is being marketed as a multi-purpose cleaning agent—for use in mechanical power washing equipment for removing oil, dirt,

IN LEAD-TIN PLATING • • •

Produce "Tailor-made" Alloy Deposits Quickly, Economically with B&A Lead and Tin Fluoborates

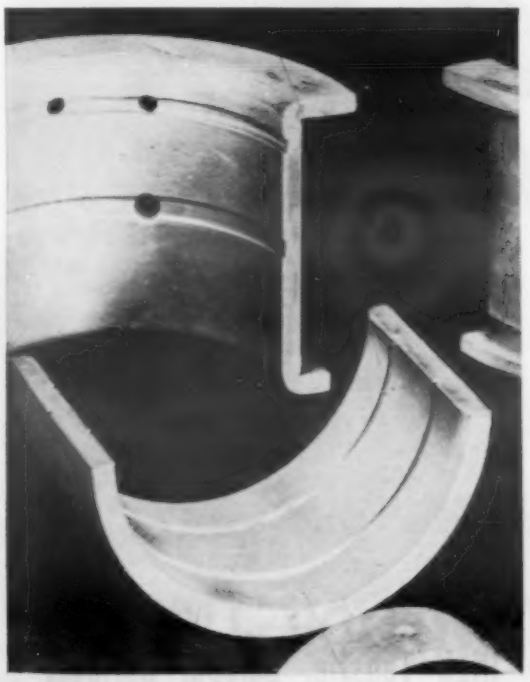
IN EVERY TYPE OF PLATING operation, electroplaters have found that Baker & Adamson Metal Fluoborate Solutions offer many advantages not available in other plating agents.

FOR EXAMPLE, in lead-tin plating, platers are able to obtain lead-tin alloys in any desired ratio with a high degree of uniformity and a minimum of control measures. This enables them to produce alloy deposits that are actually "tailor-made" for specific applications.

WHEN B&A LEAD AND TIN Fluoborate Solutions are combined in baths using alloy anodes, dense, fine-grained, uniform deposits with predetermined characteristics are plated out in one operation.

WHERE PROTECTIVE and lubricating coatings are required, lead-tin alloys of low tin content are readily plated, while alloys with 40-60% tin content can be produced where a deposit of good solderability is desired.

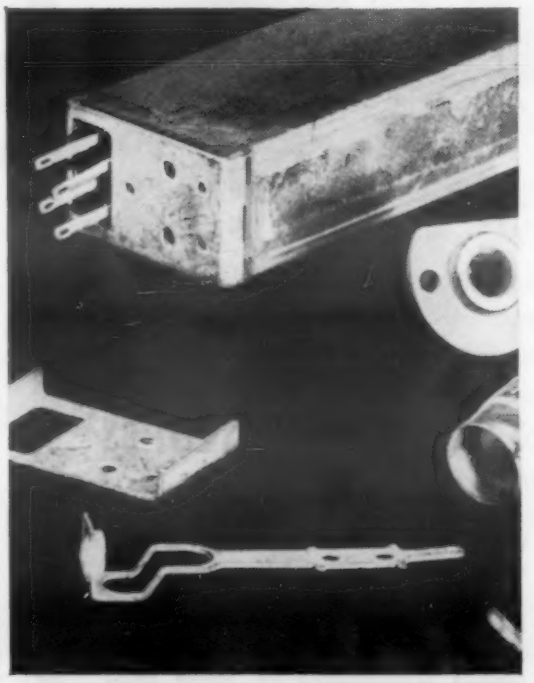
FOR DETAILED BULLETINS on lead-tin alloy plating from the fluoborate bath, or further information on B&A Fluoborate Plating Chemicals, simply fill in the coupon below, attach to your company letterhead and drop it in the mail.



Vital Engine Parts Protected with Low-Tin-Content Alloy

In plating bearings and other engine parts, the low-tin-content bath produces a protective alloy coating that has improved corrosion resistance, and is harder and more wear-resistant than lead plate alone. It is also used to deposit coatings on pistons and other parts, providing vital marginal lubrication during break-in periods.

Additional uses include plating of bi-metal wire and threaded parts where needed lubrication properties are also imparted.



Soldering Made Easy with High-Tin-Content Alloy

The high-tin-content bath produces coatings of excellent solderability on electronic or electrical parts where the use of a non-corrosive flux is desired.

Where parts can be fused, the B&A Fluoborate alloy bath is also being used to deposit solder, thus eliminating costly, time-consuming, hand-soldering operations.

B&A FLUOBORATE PLATING CHEMICALS

Lead	Nickel	Chromium*
Tin	Cadmium	Cobalt*
Iron	Indium	Fluoboric Acid
Copper	Antimony*	

*Experimental Quantities Only

REAGENTS B&A STANDARD OF PURITY FINE CHEMICALS

BAKER & ADAMSON PRODUCTS
GENERAL CHEMICAL DIVISION
Allied Chemical & Dye Corporation
40 Rector St., N. Y. 6, N. Y.

Please send me bulletins checked below.

- ☐ Lead-Tin Alloy Plating from the Fluoborate Bath
- ☐ Lead-Tin Alloy Plating in Electrotyping and Other Aplications
- ☐ Lead Plating from the Fluoborate Bath
- ☐ Tin Plating from the Fluoborate Bath
- ☐ Tin Plating of Electrotype Shells
- ☐ B&A Metal Fluoborate Solutions (outlines important applications of the various B&A Fluoborate baths)

Name_____

Organization_____

Position_____

Address_____

City_____

Zone_____ State_____

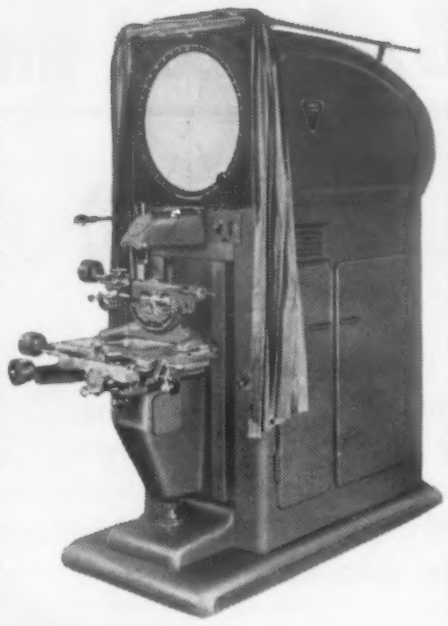
Major kinds of plating done_____

MM-6

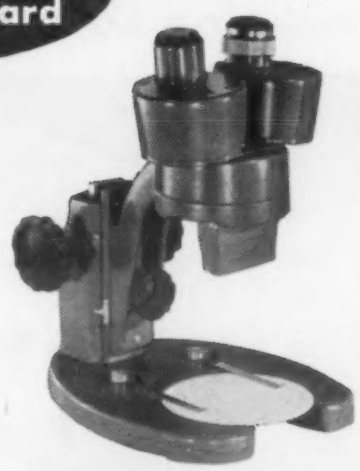
FOR *UNEQUALLED* PRECISION
in measurement, assembly, inspection . . .

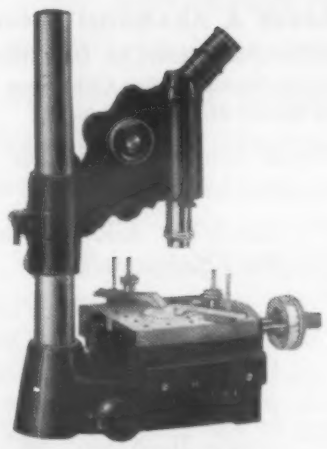
CONTOUR MEASURING PROJECTOR

Save time, money, and materials by spotting inaccuracies quickly and simply . . . with highest-precision measurements. You get angular measurements to ± 1 minute of arc with a protractor screen, and direct linear measurements to ± .0001″ over a range of 4″ by 6″ with the cross slide stage. Dimensions, angles and profiles of production-run parts can be compared directly with a *traced* outline of the projected image of the master part, or with a scale drawing superimposed on the screen. Write for Catalog D-27.



. . . industry's
UNEQUALLED standard





TOOLMAKERS' MICROSCOPE

This sturdy microscope gives you one inch linear measurements to ± .0001" and angular measurements (with protractor eyepiece) to ± 1 minute of arc. Operation is extremely *simple* and *fast.* Opaque and transparent objects of any contour can be measured. Write for Catalog D-22.

STEREOMICROSCOPES

The finest optical system ever produced for stereoscopic work assures you precision accuracy in small parts assembly operations and in inspection of tools and finished parts. You get clear, sharp, three-dimensional images, and a *wider area of focus than ever before.* The magnified image is erect and *unreversed,* for easier interpretation by the average user. These sturdy, dustproof microscopes are extensively used in industry, either alone or incorporated into machine tools. Write for Catalog D-15.

1853/1953 INTO A NEW CENTURY OF OPTICAL PROGRESS
BAUSCH & LOMB CENTENNIAL

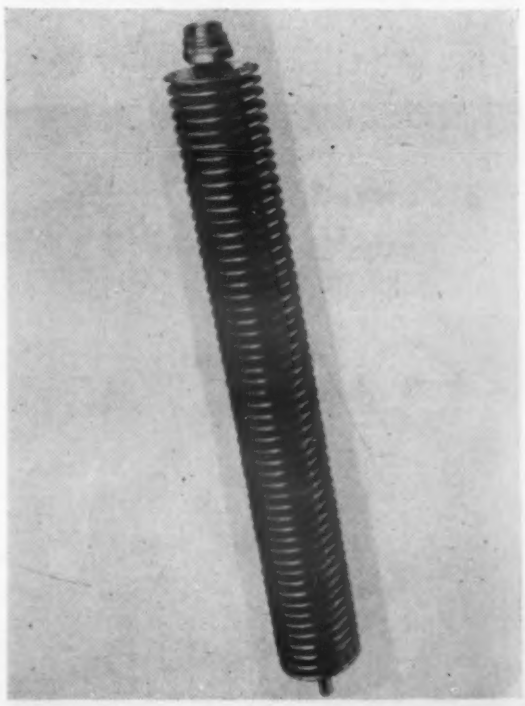
WRITE for complete information on these efficient optical aids. You may be paying many times over their moderate cost in lost time and rejects. Bausch & Lomb Optical Co., 79318 St. Paul St., Rochester 2, N. Y.

Bausch & Lomb *Quality Control* Instruments

New Materials and Equipment

chips, and abrasives from all types of metal surfaces. Other uses include: cleaning before phosphatizing; maintenance cleaning of paint; wetting out of dust and paint overspray; conditioning hard water to prevent scale or rust in mechanical washers, steam equipment and grinders.

The Powrite compound can be applied in powder washers, tanks or spray booths at concentrations of ½ to 4 oz per gal of either hot or cold water. Rinsing after cleaning is not necessary, though with some applications it might be advantageous. Dust-free, granular and water soluble, the product is low foaming, preventing lime scale deposition.



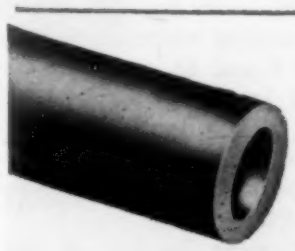
High Tensile, Smooth Surface, Porous Stainless Steel Filters

Micro Metallic Corp., 35 Sea Cliff Ave., Glen Cove, N. Y., has announced availability of a new type of porous stainless steel filter sheet, designated Grade X. The material is distinguished from previously available materials by an approximately doubled tensile strength, by extremely smooth surface, and by a very close control of thickness. This material is now available in the form of finished line of filters. Tensile strength of the porous material is in the neighborhood of 25,000 psi. The porous sheet is more ductile than previously available porous stainless steel sheet material, according to company reports.

Surface of the sheet is said to be so

you're missing something if you fail to remember

CRUCIBLE HOLLOW TOOL STEEL



Manufacturers of ring-shaped tool steel parts who don't use Crucible Hollow Tool Steel in their operations are missing a good bet. Already, some users have cut just their material costs as much as 20% by using it in place of regular bar stock.

This hollow form of Crucible tool steel is available in three famous grades: KETOS, AIRDI 150 and SANDERSON. And it is supplied with machine finished inside and outside diameters and faces — cut to your specific length requirements.

With Crucible Hollow Tool Steel, toolmakers can now eliminate drilling, boring, cutting-off and rough facing operations. This, of course, reduces production time, increases machine capacity and cuts scrap losses.

For further information, call your nearest Crucible warehouse . . . or write for new brochure describing Crucible Hollow Tool Steel, Dept. MM, Crucible Steel Company of America, Chrysler Bldg., New York 17, N. Y.

CRUCIBLE first name in special purpose steels

53 *years of Fine steelmaking*

HOLLOW TOOL STEEL

CRUCIBLE STEEL COMPANY OF AMERICA • TOOL STEEL SALES • SYRACUSE, N. Y.

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BE SURE TO SPECIFY

MISCO

MISCO PRECISION CASTINGS

- ELIMINATE EXPENSIVE MACHINING OPERATIONS
- PERMIT LARGE QUANTITY PRODUCTION IN MATERIALS DIFFICULT OR IMPOSSIBLE TO MACHINE
- MAKE POSSIBLE REPRODUCTION OF INTRICATE SHAPES AND DESIGN IN FINE DETAIL
- MAINTAIN DIMENSIONAL ACCURACY DOWN TO PLUS OR MINUS .005 PER LINEAR INCH
- ACHIEVE 70 TO 80 MICROINCH SURFACE FINISH

PIONEERS IN CARBON
STAINLESS AND HIGH-TEMPERATURE
PRECISION CASTINGS

Misco Precision Casting Company

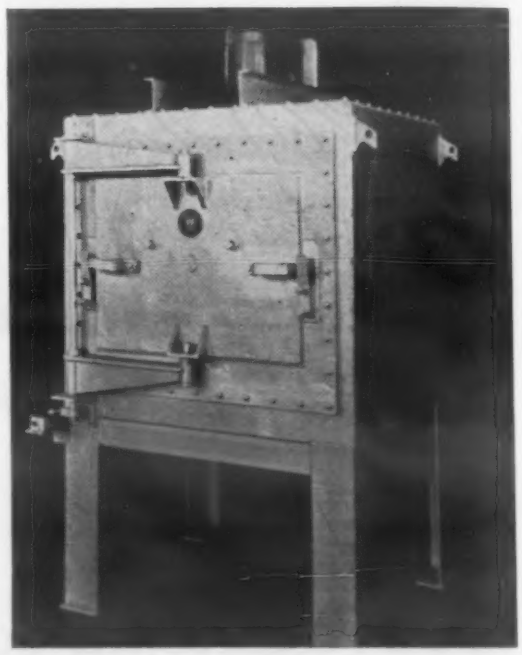
WHITEHALL, MICHIGAN

PLANTS AT: DETROIT AND WHITEHALL, MICHIGAN
OFFICES IN PRINCIPAL CITIES
TELEPHONE: WHITEHALL 2-1515

New Materials and Equipment

smooth that it is difficult, except by microscopic examination, to distinguish it from a solid sheet of stainless steel. Thickness tolerances are maintained to ±0.002 in.

Sheet material is now available in considerable quantities from stock in 0.040 in. thickness with a mean pore opening of 10 microns. Other thicknesses ranging from 0.020 in. up to ⅛ in. are either available from stock or can be supplied on short notice. Prices are comparable with the previously available porous material.



New Box Draw Furnace Available

An electric box draw tempering furnace designed for applications requiring no protective atmosphere is available from *Westinghouse Electric Corp.*, Box 2099, Pittsburgh 30. The Type DB furnace is used for batch drawing or tempering high volume work that can be handled on trays.

Maximum operating temperature of the furnace is 1400 F and an automatic temperature control accurately regulates any set heat within this range. A high velocity centrifugal fan provides uniform air circulation over the heating elements and around the charge.

To prevent uneven heating of parts around the periphery of the charge, a steel baffle provides a dead air space between the heating elements and the charge chamber.

Heat losses are reduced to a minimum through the use of a plug-in type furnace door that is designed to pivot as well as swing during opening and closing. The manually operated door also has a wide

pick the stainless that fits best

When selecting stainless steel be sure you pick the correct type for your particular application. For some grades resist corrosion better . . . others have superior heat resistant properties. Some are easier to machine . . . still others can be more readily formed or welded.

In every case there is a grade of Crucible REZISTAL Stainless Steel that is best suited to the job. And to help our customers select the type that will provide the best service for the lowest cost, we make available all the design, metallurgical, fabricating and application data we have accumulated in our years of stainless steel experience with many different industries.

Our staff of field representatives brings you the benefit of our vast technical resources. And the quality of REZISTAL Stainless Steel sheets, strip, plates, bars, wire, forgings, castings and tubing produced in our modern integrated mills is unsurpassed in the industry. When you have an application for stainless, call Crucible.

CRUCIBLE first name in special purpose steels

53 years of *Fine* steelmaking **STAINLESS STEEL**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

SMALL STAMPINGS

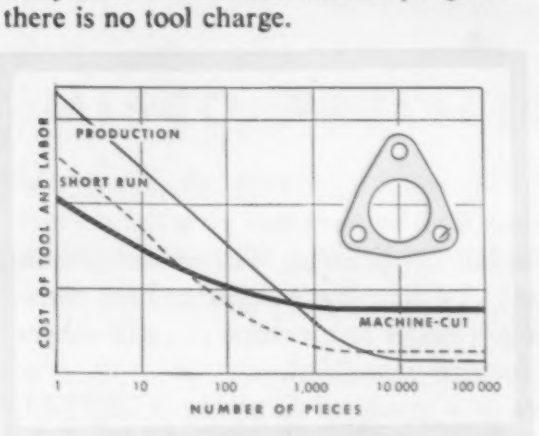
A COST-SAVING, VERSATILE APPROACH TO THEIR MANUFACTURE

Possibly you've always thought that a quick look at the quantity involved decides how a stamping shall be made. Sometimes it is done that way but it isn't the sure way to lowest costs.

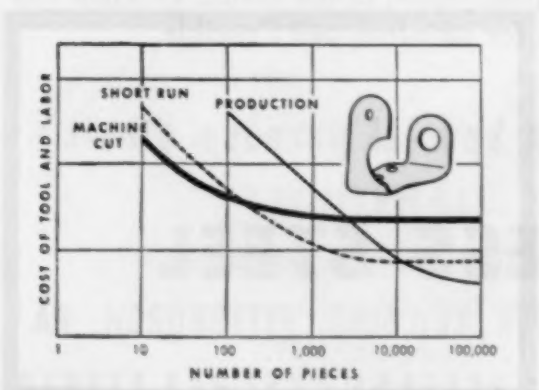
A more scientific approach by the STAMPINGS DIVISION of the Laminated Shim Company in Glenbrook, Connecticut frowns on the term "short run stamping." There is what is known as the short run *method* but there is no definite dividing point between short run and production quantities. Contour, tolerances, material, many other items all affect the manufacturing method when costs are being carefully figured.

NO ONE METHOD IS ALWAYS CHEAPEST; THREE ARE NEEDED

Machine-Cut Method: The STAMPINGS DIVISION goes one step further than Short Run and Production Methods. The Machine-Cut Method, though not strictly a stamping operation is a valuable addition to stamping procedure Custom built slitters, cutters, saws and files use experience-gained techniques to fashion the smaller quantities of parts. No dies are made; only stock punches are used. Obviously labor cost is understandably high but there is no tool charge.



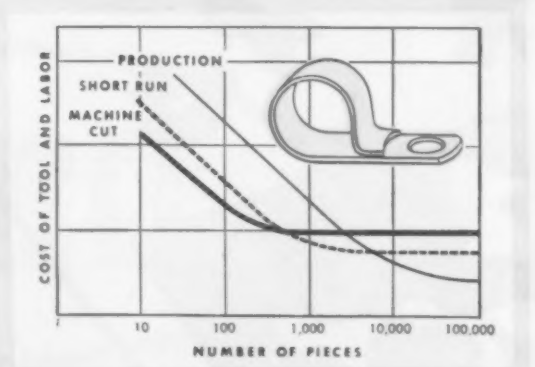
Short Run Method: As quantities increase (and depending upon the complications of contour, material, etc.) the economy of a temporary blanking die must be considered to eliminate the labor expense of machine-cutting. When this point is reached, manufacture is by the Short Run Method and the blanking is supplemented by other bench press operations. Here labor cost is at a medium level but a modest tool charge is incurred.



Production Method: As quantities increase the Production Method using standard dies with high speed automatic presses becomes more attractive. A relatively high tool charge can then be amortized over a great number of parts. Labor charge is negligible.

The Production Method as developed by the STAMPINGS DIVISION is offering unusual cost saving possibilities because of the new low-cost, full service Hecht-type die developed by the company for certain applications.

It is interesting to note that sometimes a very small quantity of parts would require a standard die because of complications or close tolerances or tough materials involved. Thus occasionally a very small quantity goes into the production classification.



LOWEST COST IS ASSURED WHEN SUPPLIER HAS ALL THREE METHODS

The illustrations show typical stamped parts along with relative costs and breaking points for each of the three manufacturing methods. Unless a supplier can offer all three, his costs cannot always be low. For a given quantity, only *one* method can be most economical.

ONE OR ONE MILLION PARTS FROM SAME SUPPLIER

An important corollary to the above is that an experimental part in small quantities can be handled by the same supplier when full production quantities are needed

Further, it is important that a supplier be fully informed, if possible, on later or total requirements for a given part. As the charts point out, such information will affect manufacturing method and make possible cost reductions.

FURTHER INFORMATION AVAILABLE

An illustrated 12 page brochure describing in greater detail the methods mentioned above is available on request to the
STAMPINGS DIVISION
Laminated Shim Company, Inc.
8706 Union Street, Glenbrook, Conn.

New Materials and Equipment

overlap and a machined face to provide a tight metal to metal seal.

The furnace is available in six sizes ranging from 15 by 24 by 12 in. to 42 by 72 by 30 in. The five larger sizes utilize 480 v and the smallest, 240 v.

Teflon-to-Teflon Sealing Process

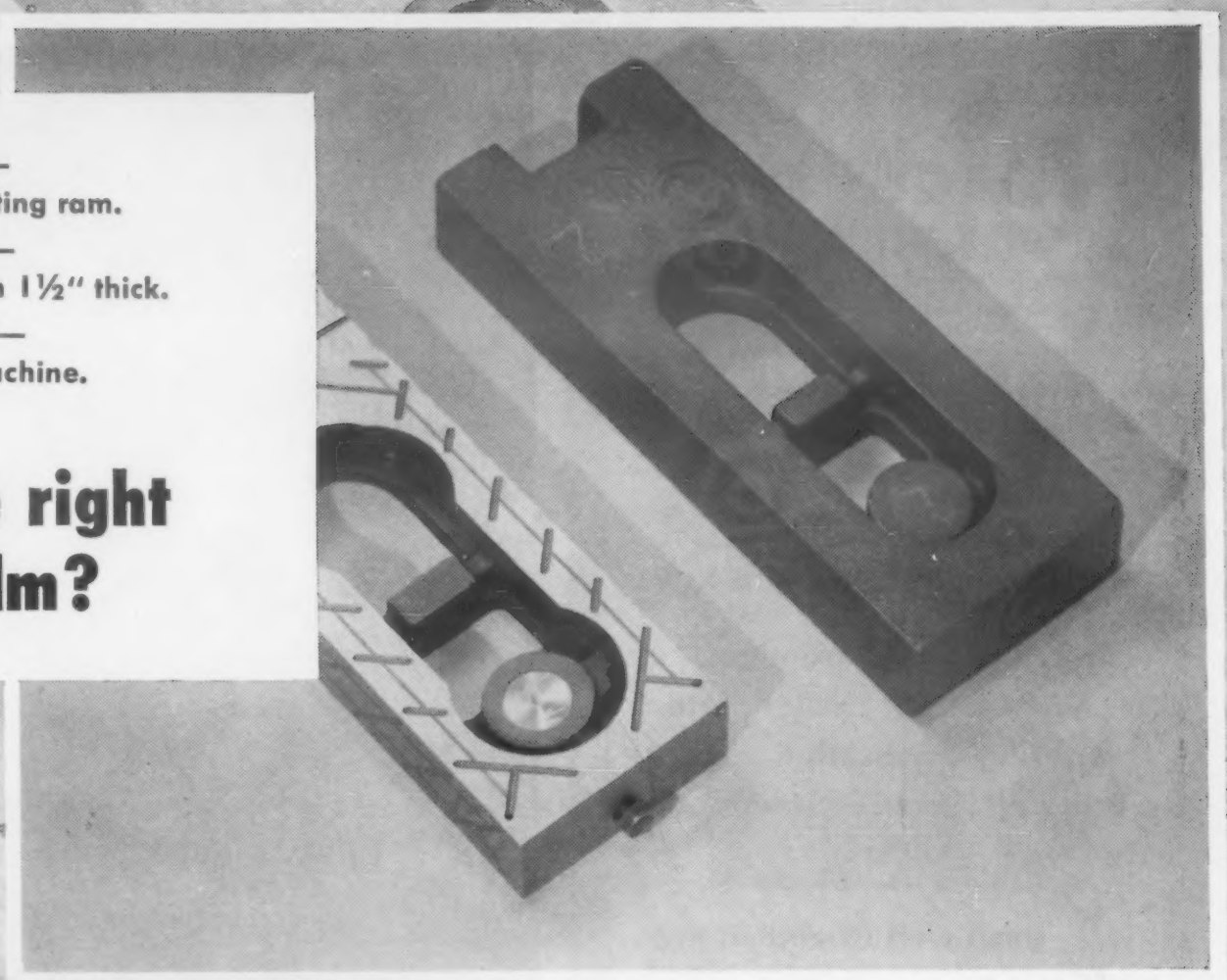
Materials Engineering, Inc., P.O. Box 272, Orange, Calif., has developed a Teflon-to-Teflon sealing process which is said to impart to the seal the same chemical and high temperature properties characteristic of the parent material. The joint of this seal has a tensile-shear strength equal to the tensile strength of Teflon.

According to the company, the development opens the way for the application of Teflon film to bags, fuel cells, tank liners, protective clothing and special services where the sealing of Teflon is required. Teflon film, now only available in widths up to 12 in., can be produced in any desirable width through this sealing process. Teflon has also been bonded to metals utilizing variations of this process.

New Flux for High Temperature Brazing

A new flux with extra penetration and protection for high temperature brazing and hard soldering of ferrous and nonferrous metals has been announced by *Special Chemicals Corp.*, 30 Irving Place, New York. Because of its greater film strength, Kwikflux No. 94 is said to eliminate island formation, prevent oxidation and scale, protect and clean metal surfaces when brazing at high temperature, and to be nonspattering. Deeper penetration power of the patented phosphate formula gives extra bite and better capillary action in long, deep joints. Kwikflux No. 94 is also guaranteed to work with all standard silver, brass, bronze and other hard solders and all types of heating applications, direct, indirect and induction heating. It meets all rigid government specifications.

The flux's good wetting action is said to speed work, eliminate lumping or pitting of solder. Its flowing speed resists evaporation, flows faster, works cleaner, and eliminates skip spots, saving time and costs.



PRODUCT—
Casting for reciprocating ram.
MATERIAL—
High-strength cast iron 1½" thick.
EQUIPMENT—
220 kv x-ray machine.

What's the right X-ray film?

KODAK INDUSTRIAL X-RAY FILM, TYPE K

This casting, worth about $2, is headed for machining, heat treating and scraping worth $375. It's no time to take a chance on hidden faults.

So the radiographer checks each casting and discards the unsound.

For these radiographs he uses 220 kv at a distance of 40 inches, lead screens, and Kodak Industrial X-ray Film, Type K—the right choice for this thickness of iron and x-ray equipment.

THERE'S A RIGHT FILM FOR EVERY PROBLEM

Whatever your radiographic problem, you'll find the best means of solving it in one of Kodak's four types of industrial x-ray film. This choice provides the means to check castings and welds efficiently, offers optimum results with varying alloys, thicknesses and radiographic sources.

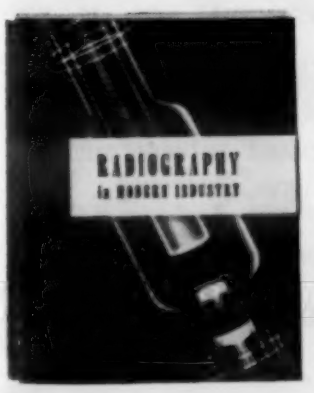
Type K—has medium contrast with high speed. Designed for gamma ray and x-ray work where highest possible speed is needed at available kilovoltage, without use of calcium tungstate screens.

Type A—has high contrast and fine graininess with adequate speed for study of light alloys at low voltage and for examining heavy parts at intermediate and high voltages. Used direct or with lead-foil screens.

Type M—provides maximum radiographic sensitivity, with direct exposure or lead-foil screens. It has extra-fine grain and, though speed is less than Type A, it is adequate for light alloys at average kilovoltages and for much million- and multi-million-volt work.

Type F—provides the highest available speed and contrast when exposed with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays when exposed directly or with lead screens.

Radiography... another important function of photography



RADIOGRAPHY IN MODERN INDUSTRY

A wealth of invaluable data on radiographic principles, practice, and technics. Profusely illustrated with photographs, colorful drawings, diagrams, and charts. Get a copy from your local x-ray dealer—price, $3.

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X-ray Division · Rochester 4, N. Y.

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of successful uses of

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replacing Chromium, Cadmium or Nickel plate, offering Corrosion-Resistant, Brilliant Finish at Lowest Cost

- ✓ Cabinet hardware
- ✓ Small tools (wrenches, etc.)
- ✓ Auto body parts
- ✓ Bathroom hardware
- ✓ Aircraft metal parts
- ✓ Wire goods
- ✓ Refrigerator shelves
- ✓ Radio speakers, chassis, shields
- ✓ Television parts
- ✓ Electrical parts
- ✓ Air conditioning fans, guards, etc.
- ✓ Bolts, nuts, washers, rivets
- ✓ Builders' hardware
- ✓ Outdoor metal articles (fences, trailers, etc.)

also

- ✓ Protective finishes

covered by Federal Specifications for Army Signal Corps, Army Ordnance, Army and Navy Aeronautical.

THE Chemical CORPORATION
67 Waltham Avenue, Springfield 9, Mass.

Fingerprint stains are one of the commonest types of discoloration that sometimes are difficult to remove.

How to Clean Stubborn Deposits from Stainless Steel

Here are some useful tips on removing a variety of stains and discolorations commonly encountered in stainless parts fabrication.

● OILY STAINS, inked stencil marks and heavy discoloration still pose difficult problems for many fabricators of stainless steel.

To combat such production bottlenecks, the research laboratories of Armco Steel Corp. have issued a few cleaning tips to stainless fabricators.

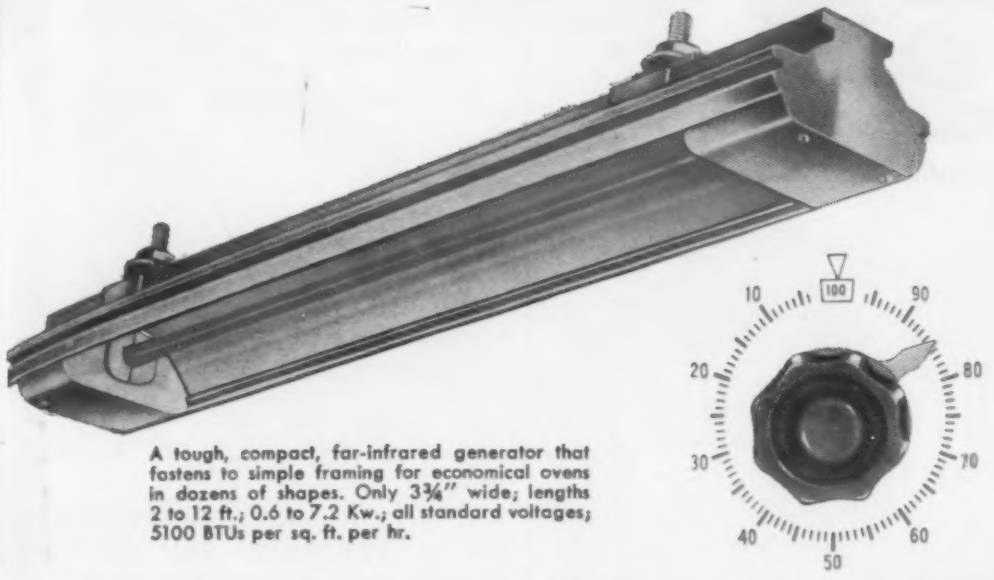
Oily Stains

For removing fingerprints, oil, grease, wax, greasy dirt and other oily stains, the following procedure is recommended:

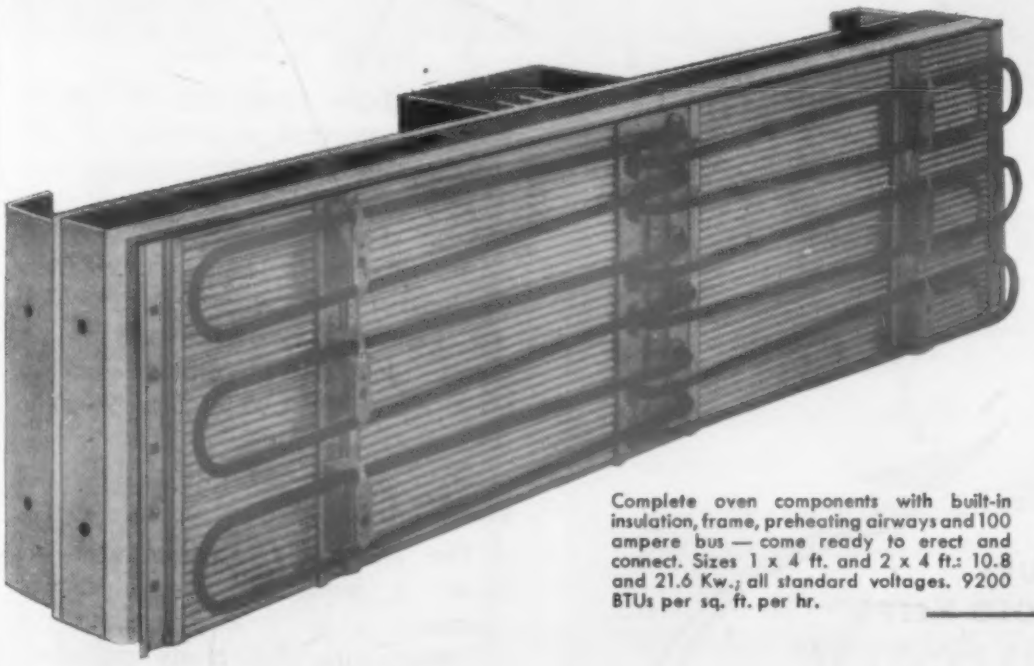
1. Make a sudsy solution of "Tide" or similar detergent and water (detergent acts as wetting agent).
2. Add about one-fourth as much carbon tetrachloride or a similar chlorinated solvent such as trichloroethylene (solvent).

(*Continued on page 254*)

uniform heat . . .
precise heat . . .
fast heat . . .
"**color blind**" heat . . .



A tough, compact, far-infrared generator that fastens to simple framing for economical ovens in dozens of shapes. Only 3¾" wide; lengths 2 to 12 ft.; 0.6 to 7.2 Kw.; all standard voltages; 5100 BTUs per sq. ft. per hr.



Complete oven components with built-in insulation, frame, preheating airways and 100 ampere bus — come ready to erect and connect. Sizes 1 x 4 ft. and 2 x 4 ft.; 10.8 and 21.6 Kw.; all standard voltages. 9200 BTUs per sq. ft. per hr.

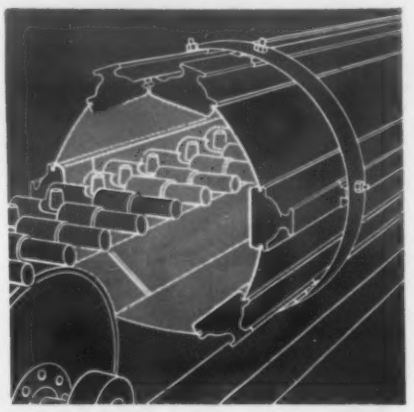
A Chromalox Electric Radiant Panel or Chromalox Radiant Heater installation gives you a quick, low-cost answer to your baking, curing, drying and other heating needs. Pre-engineered units allow on-the-spot erection and connection. You get up to 700° F. work temperatures; absolutely uniform radiation with no hot and cold spots; high intensity heat that's absorbed *f-a-s-t* by all colors; and accurate "dialed" heat from 0 to 100% of capacity.

CHROMALOX *Electric*

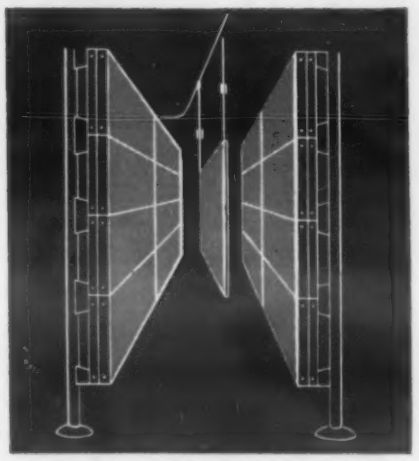
Far-infrared Units

TWO JOB-PROVED FAR-INFRARED TYPES TO CHOOSE FROM!

You'll find Chromalox pre-built Radiant Panels and Heaters from stock fit your jobs and your budget. Shown below are just two of the literally hundreds of oven shapes and sizes which can be erected quickly and easily using Chromalox Electric Radiant Units.



Conveyorized oven built on the job using Chromalox Radiant Heaters. Units are installed in lengths and ratings needed to fit the work. Input controller gives precise and exact temperatures easily adjusted to meet varied processing requirements. Easy to assemble, easy to wire.



Chromalox pre-engineered Radiant Panels are easily and quickly erected and connected to form ovens and drying tunnels of any size and shape. An oven such as sketched may be installed in 20 to 30 man-hours with minimum engineering expense and lowest cost per installed kilowatt.

Have a Problem Involving Degreasing, Drying, Baking, Preheating, Curing?

The assistance of Chromalox Application Engineers is yours for the asking. They'll help you work out your specific requirements without obligation. Write today.

EDWIN L. WIEGAND CO. IC-70
7523 Thomas Blvd., Pittsburgh 8, Pa.

I'm interested in electric heat for.....
.....
.....

☐ Send me Bulletins on Far-infrared units.
☐ Have a Chromalox Application Engineer get in touch with me.

Name.....
Company.....
Street.....
City.....Zone.....
State.....

See how QUALITY at

per Mold

FOREMOST MFR'S. OF FINE ALUMINUM CASTINGS

is controlled to help you at the foundry level of production

NEW BROCHURE
SHOWS HOW PERMOLD KEEPS
QUALITY CONTROL
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Ask for your copy—a pictorial description that shows how continuous, scientific control of Permold aluminum casting quality, *to specifications*, saves you time and money.

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perMold
COMPANY
820 West Liberty Street
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Please send new brochure, "Quality Control Under Control," describing modern casting methods and facilities at PERMOLD.

Name_____

Position_____

Company_____

Address_____

Cleaning Stainless Steels . . . .

continued from page 252

3. Shake or stir solution vigorously.
4. Using rubber gloves, wipe solution over stains with a cloth.
5. Rub lightly or permit to stand for a few minutes.
6. Rinse with clean water.
7. Fingerprints can then be removed with "Glass Wax", made by Gold Seal Co., Bismarck, N. D., and this treatment will help prevent fingerprinting.

Precaution: Carbon tetrachloride should be used only in a well-ventilated place.

Heavy Discoloration

For removing heavy surface discoloration and heat tint, the following procedure is recommended:

1. Clean off oil and dirt by means of the procedure described above.
2. Apply special cleaner Oakite No. 33. (To remove heat tint, leave the solution on the surface for at least an hour.)
3. Rinse.
4. Repeat as necessary.

The above treatment, of course, will not prevent recurrence of the discoloration.

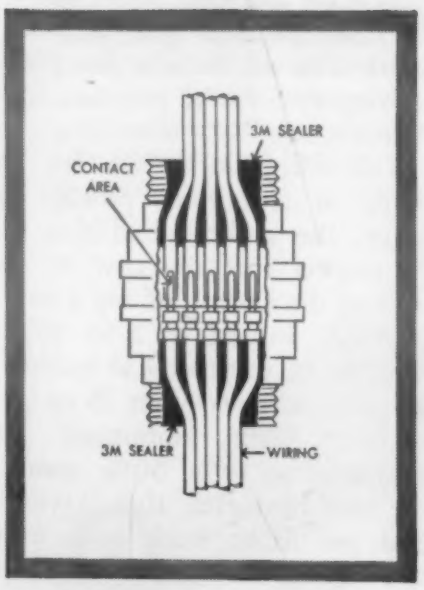
Sometimes colored trademark stencils on stainless sheets detract from a uniform finished appearance. Stencil marks and grease pencil marks can generally be removed by the simple detergent treatment, but if they persist the Oakite No. 33 solution should be used.

Powder Cleansers

The Armco instructions also include a warning about powder cleansers.

Recognizing that many manufacturers use a dry powder or a paste to remove fingerprints, collected dust and other light deposits after fabrication, the laboratories caution fabricators against using cleansers which scratch or tarnish the stainless surface.

Cleansing powders should definitely not be used on millrolled finishes, according to Armco. Even a very fine powder will scratch a finish such as No. 2B. Cleansing powders are satisfactory, however, on polished sheets having a scratch finish, such as No. 4 polish. When used, the powder should be wiped in the direction of the scratches, not across them.



Keeping your power dry!

Protecting our shores from invasion is only one of the jobs assigned to Navy aircraft. Another task, equally important, is for the plane to protect itself against its own "natural" enemies.

For instance, consider the possible effects of salt air and water, of moisture condensation, of vibration on the electric wiring that delivers power throughout the plane. How quickly these elements would destroy the aircraft—if not checked.

To help protect these power lines, 3M, working with McDonnell engineers and the U.S. Navy, developed EC-1120—a potting compound, not affected by vibration, that provides a permanent seal for wiring in plugs against moisture and salt air. It helps to keep your power dry!

See what adhesives can do for you . . .

There are virtually thousands of other 3M products developed for specific uses such as this, or for more general purposes. For the facts on 3M adhesives, sealers and coatings designed especially for industrial use, call in your 3M sales representative, or write directly to 3M, Dept. 66, 411 Piquette Ave., Detroit 2, Michigan.

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Cleaning Stainless Steels . . . .

continued from page 252

3. Shake or stir solution vigorously.
4. Using rubber gloves, wipe solution over stains with a cloth.
5. Rub lightly or permit to stand for a few minutes.
6. Rinse with clean water.
7. Fingerprints can then be removed with "Glass Wax", made by Gold Seal Co., Bismarck, N. D., and this treatment will help prevent fingerprinting.

Precaution: Carbon tetrachloride should be used only in a well-ventilated place.

Heavy Discoloration

For removing heavy surface discoloration and heat tint, the following procedure is recommended:

1. Clean off oil and dirt by means of the procedure described above.
2. Apply special cleaner Oakite No. 33. (To remove heat tint, leave the solution on the surface for at least an hour.)
3. Rinse.
4. Repeat as necessary.

The above treatment, of course, will not prevent recurrence of the discoloration.

Sometimes colored trademark stencils on stainless sheets detract from a uniform finished appearance. Stencil marks and grease pencil marks can generally be removed by the simple detergent treatment, but if they persist the Oakite No. 33 solution should be used.

Powder Cleansers

The Armco instructions also include a warning about powder cleansers.

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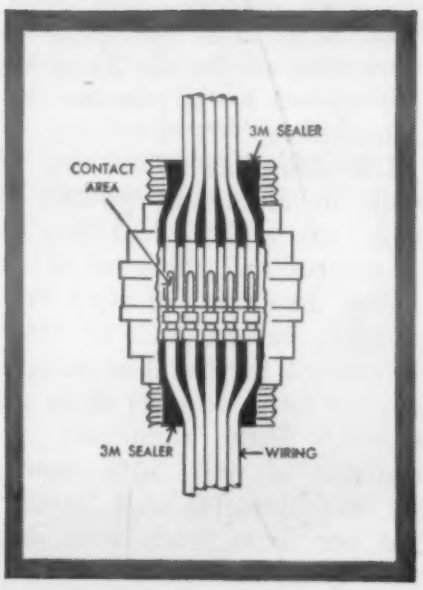

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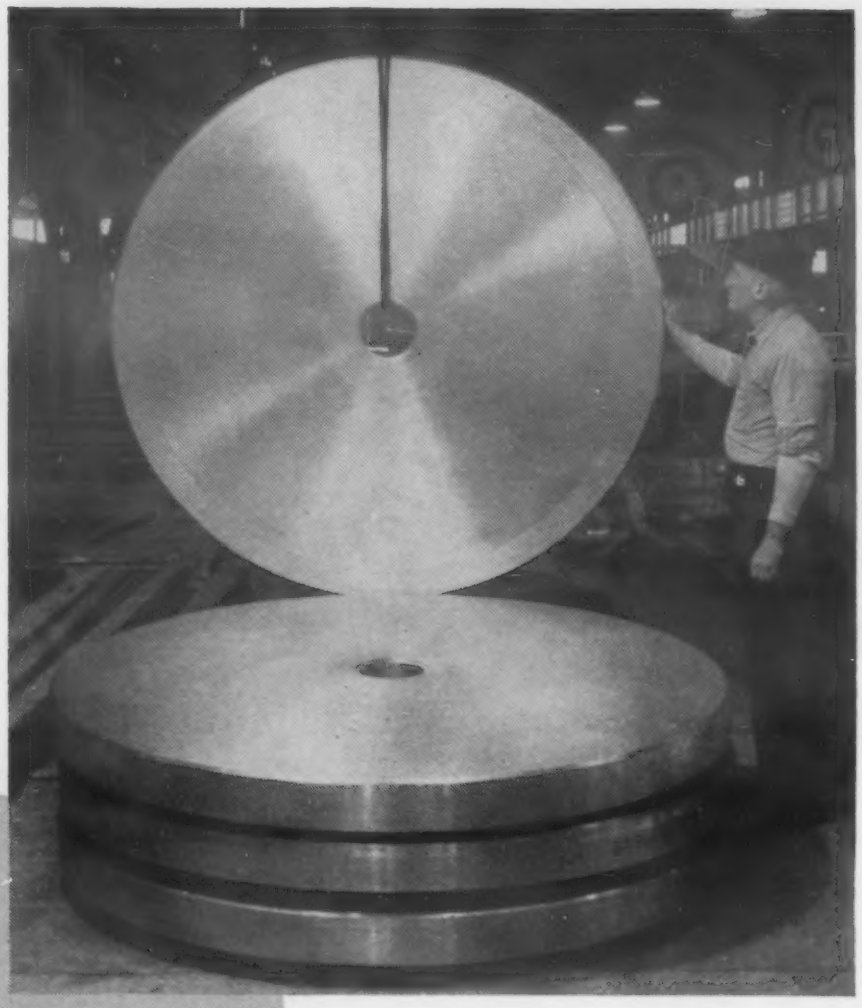

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News Digest

Powder Metallurgy . . . .

continued from page 11

added, "sells for half again as much as aluminum pig".

The authors brought out three significant facts regarding aluminum powder metallurgy:

1. That the use of a powder lubricant is detrimental to the development of adequate final strength under conventional sintering conditions.

2. That an unlubricated aluminum compact can be sintered in a variety of atmospheres, including still air, to develop physical properties closer to the mechanical properties of the wrought metals than is the case with most other base metals.

3. That lubricating the moving surface of the punches and die is an absolute requirement if more than one of the above compacts are to be removed from the die.

"There appear to us to be two fruitful approaches to the problem," said Mr. Haertlein. "The one which we belive to be the most promising to the solution of the lubrication problem is the force lubricated lower punch for uncored pieces and a combination of this with a force feed lubrication of the die for pieces requiring two lower punches for their manufacture."

Discussing incentives for further work in aluminum powder metallurgy, the authors had this to say: "I suspect that the cost of an aluminum die casting of say 4 to 8 oz is probably valued at 2 to 2½ times the cost of the metal at today's market, say 48 to 60¢ per lb or perhaps higher. With aluminum powder available at only 50% more than the cost of metal, that leaves 18 to 30¢ per lb to work with in fabricated costs, tool amortization, profit, etc. Aluminum powder is being produced in larger tonnages than any other metal powder today. An expansion of primary metal production facilities is going forward at an unprecedented pace so that it now exceeds the volumetric production of every metal except iron and steel."

Brass Powder Parts

D. C. Bradley, New Jersey Zinc Co., and W. R. Toeplitz, Bound Brook Oil-Less Bearing Co., reported on the quality of brass powder parts, long a controversial subject. To determine the relative

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ELLIOTT Company, a leading fabricator of motors and generators, uses silver alloy brazing almost exclusively on D.C. machines, and on all damper and squirrel-cage windings and most coil connections on A.C. units. The alloys primarily used are the low-temperature silver brazing alloys EASY-FLO and SIL-FOS.

Silver alloy brazing commutator risers to armature coils and cross connectors.

On D.C. machines, compensating field connections are silver alloy brazed. Elliott brazes with the incandescent carbon tong-type of heating for lap joints.

Considering ELLIOTT's established reputation for engineering excellence and product quality, their use of EASY-FLO and SIL-FOS is pretty conclusive evidence that these alloys best satisfy the metal joining requirements of electrical equipment.

ELLIOTT says—"Experience and test have proven that silver alloy brazing produces far superior joints . . . joints that are extremely strong—in all cases, higher than the yield strength of the copper . . . joints that are ductile, enabling them to withstand the stresses and strains of shock loading, vibration and temperatures equally as well as the copper itself . . . joints that have low resistance and do not deteriorate with time . . . joints that can be readily opened when necessary, and reclosed to original quality."

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News Digest

merits of brass powder parts, tests were conducted on five separate materials: a prealloyed 80-20 leaded brass, a typical low density bronze bearing material, a high density bronze structural part alloy, a 90 iron-10 copper alloy, and a normal density plain iron.

From the results obtained in these tests, the authors concluded that "the comparisons of brass with other materials confirm the experiences in producing many hundreds of tons of prealloyed 80-20 leaded brass and the fabrication of this material into millions of highly successful civilian and military parts.

"The production of sintered brass, like all other sintered materials," said Mr. Bradley, "depends for its success on the painstaking, continuous control of the variables inherent in the process. In brass fabrication, as in cake baking, there are a few precautions which are necessary to produce a satisfactory product. It might be said that practically all of these precautions are also necessary to produce satisfactory parts from any of the other metal powders and alloys".

Hydride Alloy Powders

The properties and characteristics of alloy powders produced by the hydride process were discussed by B. A. Gruber, Metal Hydrides, Inc. He reported on work completed and contemplated, the goal of which is to provide tailor-made alloy powders to meet given requirements of strength, corrosion resistance, high temperature resistance and the like.

An initial phase of their work was evaluating the use of fully alloyed chromium-nickel powders in combination with iron powder. The results show an appreciable increase in strength over iron powder alone. Thus, Mr. Gruber pointed out that such powder combinations offer considerable promise where high strength is required. Another practical advantage is the ability to get good strength properties from blends of these alloys with iron powders by the simple steps of compacting and sintering as contrasted to more complex procedures now being used in many powder metallurgy applications.

Plastic Impregnants

Nonmetallic impregnation of sinterings was described by W. N.

We make all kinds of bolts

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Long bolts. Short bolts. Thin bolts. Fat bolts. Special bolts. Bolts with cut or rolled threads, to meet any specification . . . Yes, we make all kinds of bolts, and in just about every size.

Bethlehem bolts are good bolts. They have strong heads and shanks, and smooth-fitting threads. You can count on them for dependable performance.

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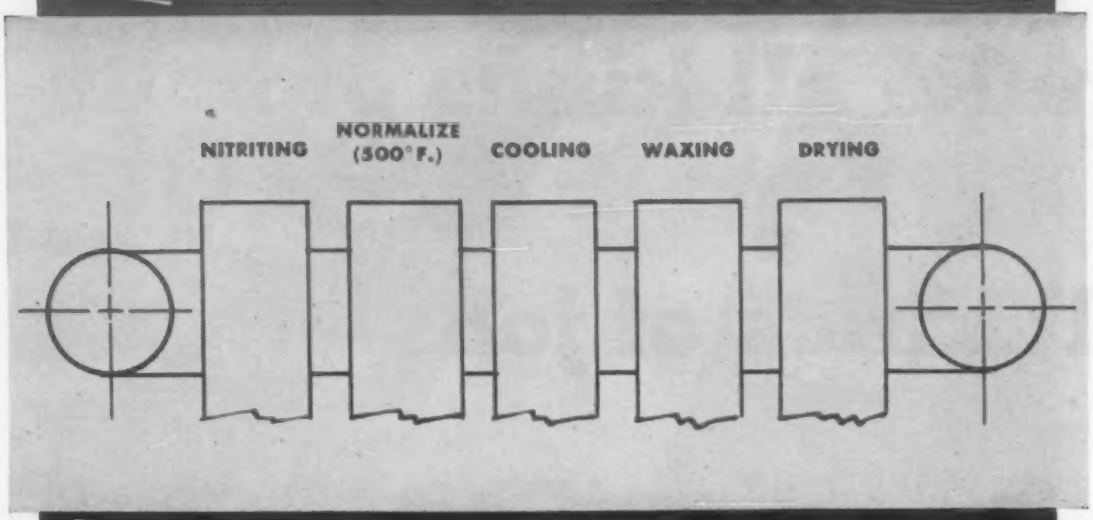

help spring producer boost output 350% in 30% less floor space!

110 old-fashioned hand trucks no longer needed! 15 truck operators freed for more productive work! Floor space requirements cut by 30% . Output rose from 290,000 pieces in 24 hours to 680,000 pieces in 16 hours, *an hourly increase of 350% !*

These were the results of this installation of a 98′ Cambridge wire mesh belt in a large spring producing plant. The moving belt gives continuous production, eliminates the need for hand trucks in transferring the work from one step to the next, assures uniformly processed work.

Perhaps Cambridge wire mesh belts can help you get similar savings. They're available in any metal or alloy, mesh or weave, length or width. They can be used under practically any conditions . . . from temperatures as high as 2100° F. down to sub-zero, for handling work through simple water rinses or highly corrosive acid sprays, for carrying small delicate parts or heavy, bulky loads. All-metal belt construction assures long life and freedom from damage. Open mesh permits free drainage of process solutions or free circulation of process atmospheres.

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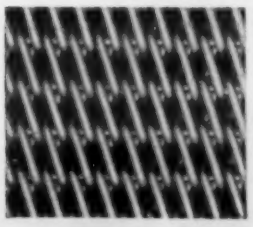
You can rely on his experienced advice to recommend just the right type of wire mesh belt for your process. Look under "Belting-Mechanical" in your classified phone book for the Cambridge office nearest you.



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News Digest

Pratt, American Metaseal Manufacturing Corp. Proper impregnation is particularly valuable in the prevention of plating failures, declared Mr. Pratt. Porous areas have a tendency to absorb plating and cleaning solutions and these exude and "spot out" after the plating cycle is complete—a problem particularly serious in the powder metallurgy field. A manufacturer of adding machines using pinion gears of sintered iron found it impossible, said Mr. Pratt, to cadmium plate the parts successfully. The original parts were plated by approved methods, yet the parts were badly corroded after only ten days' exposure in test. Mr. Pratt showed that if these same parts were impregnated before cadmium plating, there was no evidence of corrosion after a five months' test. The reason, he said, is that impregnating before plating seals each pore with a dielectric material which not only prevents the platers' solutions from becoming entrapped, but does not allow an electrolytic "circle" to start in the pore. In a similar manner, he pointed out, proper impregnation prevents failure of organic coatings on sintered metal parts and opens up a new field for the development of pressure tight parts.

Status of Field

Robert L. Ziegfeld, Secretary of the Metal Powder Association, gave a report on the results of a comprehensive survey conducted by the Metal Powder Association among iron powder producers and potential producers to determine the real iron powder supply picture and the potential producing capacity. By mid 1953, said the report, iron powder producing capacity in the United States and Canada will have increased by nearly 200% over the capacity at the beginning of the year. The survey also revealed that about 59% of present production was going into the manufacture of bearings and mechanical parts; about 28% is being used for scarfing; 10.5% for electronic applications; and smaller percentages for pharmaceuticals, friction materials and other uses. Approximately one-half of the available iron powder at present is suitable for use in ordnance and other military applications, exclusive of electronics, and this percentage will be raised considerably by the new capacity, according to the survey.

Taking a perspective view of pow-

FACTS ABOUT GB BRAZING ALLOYS AND FLUXES . . .

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There is one sure way for you to learn just how GB Alloys and GB Fluxes team together to give maximum results on low temperature brazing applications—that is; try them in your own shop and on your own specific jobs.

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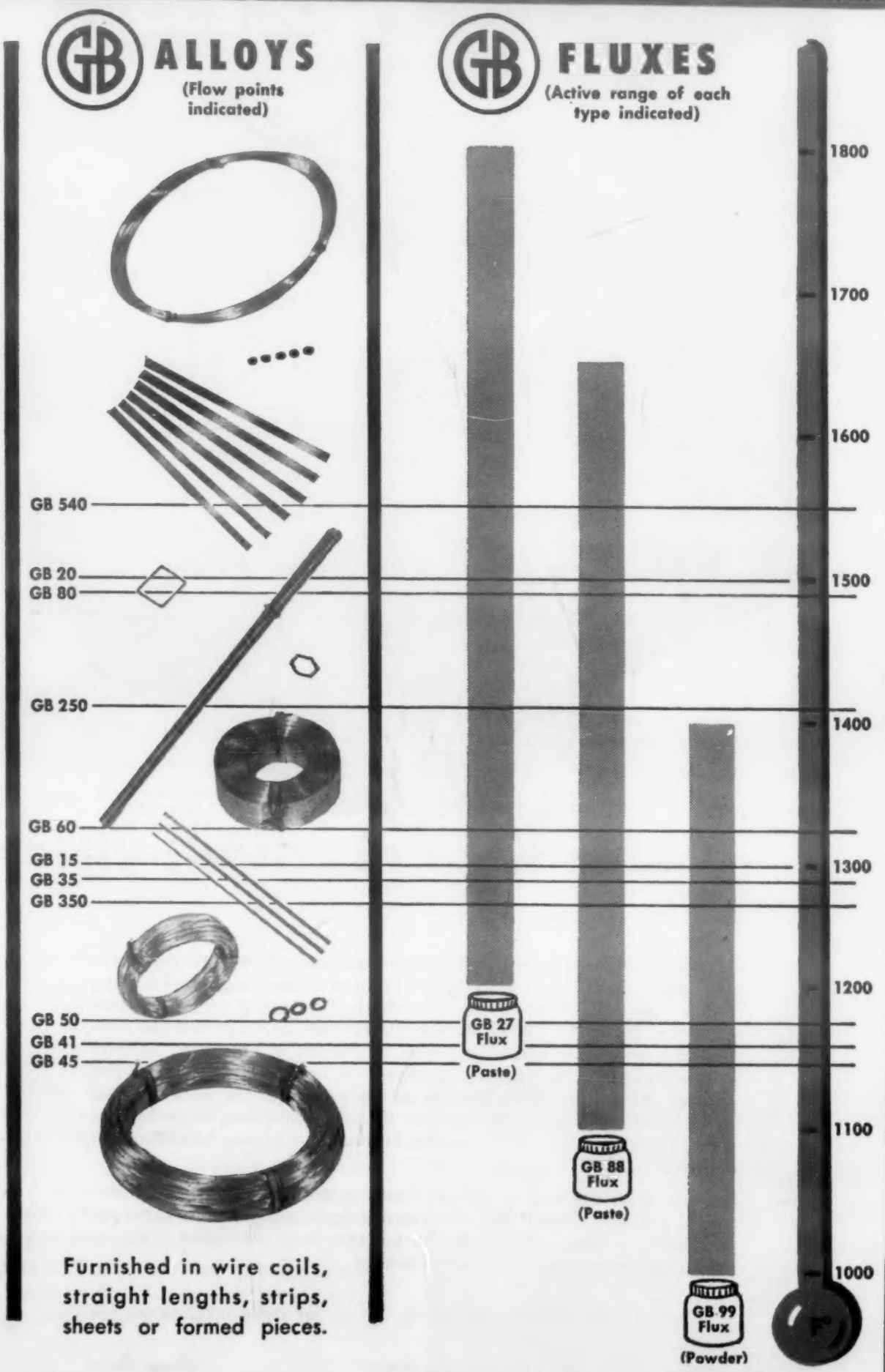
GB 22 Flux is a high temperature brazing flux with an active range of 1200°F to 2000°F. Exceptionally fine powder makes up into a smooth paste when mixed with water. Low glare and non-fuming at any heat.



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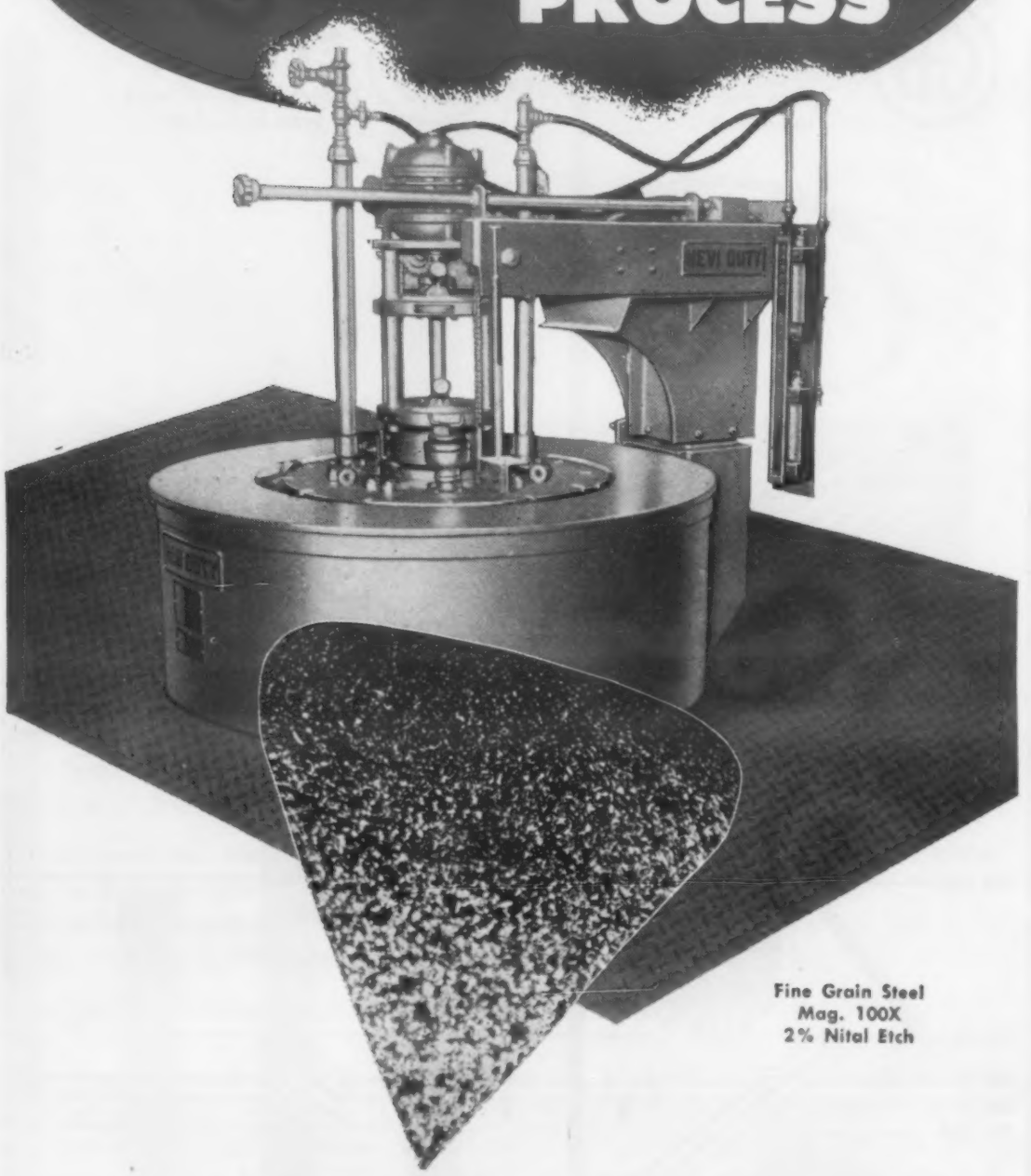

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Hevi Duty Carburizer-Nitrider Furnaces are now equipped for controlled pressure carburizing. Inexpensive accessories can be provided to convert existing Hevi Duty Carburizers into controlled pressure carburizers to give you true carbon control.

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News Digest

der metallurgy as an industrial technique, John D. Shaw, S-K-C Research Associates, gave his impressions of the present and future status of powder metallurgy. "Powder metallurgy is at the cross roads," said Mr. Shaw. "Many new applications are waiting that are naturals for powder metallurgy." He cited the establishment of standard powder specifications as an aid to expanding the present field of applications.

What Happens When DMS Starts

The materials supply picture will undergo some major changes starting July 1. On that date the new "Defense Materials System" will go into effect, replacing the "Controlled Materials Plan."

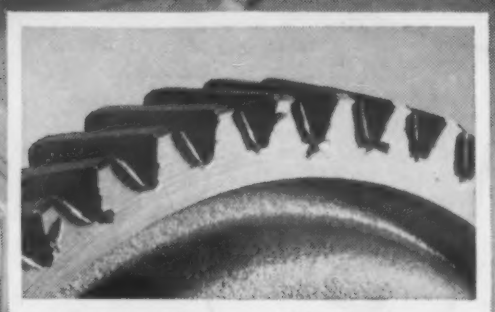
The new orders wipe out priority and allotment authority for civilian and defense-supporting producers. But they will continue the funneling of needed materials to military and atomic energy producers and builders. And one class of materials —nickel-bearing stainless steels and similar highly-alloyed materials—will still be allocated to *all* users. Civilian and defense-supporting producers will have to buy all other materials in the open market.

Big Three Controls Relaxed

Steel, copper and aluminum will still be known as "controlled materials" after June 30, but the controls will be limited to assuring deliveries of enough of those materials for the Department of Defense and the Atomic Energy Commission. Up to now the government has been allocating the major metals not only for defense purposes but for the entire civilian economy. Direction 21 to CMP Regulation No. 1 provides for the transition from CMP to DMS for manufacturers.

Producers of the three major metals are already accepting unrated orders for delivery after June 30. However, the new directive requires that authorized controlled material orders accepted for shipment before July 1 and carried over into the third quarter must be given prefer-

OSBORN



BEFORE: Closeup of helical gear before deburring.

Gone . . . costly thorns in their side

Burr removal by muscle methods is aggravating because it is costly, inefficient and non-uniform in quality. Here's how a truck manufacturer has banished these "thorns in the side" with push-button brushing.

The operation: to deburr, break and blend the flank edges of gear teeth prior to shaving and heat treating. Formerly done with a hand tool, in several operations, the work was tedious and required close inspection and reworking to meet rigid specifications.

Now, an Osborn Brushing Machine in one speedy operation smooths the entire tooth edge . . . produces *uniform blending* of surface junctures of *every tooth*. Result: lower costs and greater precision for *better performance* of the product in service.

Find out how *you* can cut your costs and improve *your* products with power brushing. Call the nearby **O**sborn **B**rushing **A**nalyst or write *The Osborn Manufacturing Company, Dept. N-3, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

AFTER deburring with Osborn Brushing Machine.

Osborn Brushes

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This is a high chrome alloy — 24% chromium and 12% nickel — an excellent alloy for meeting the conditions imposed when handling molten aluminum. As you can see the casting is approximately 6 inches in diameter — not a big casting as many Duraloy products go but indicative of what we can do in the way of small castings.

Our experience in this business of high alloy castings goes back to 1922 and we also pioneered work in the centrifugally cast high alloys which we inaugurated back in 1931. So we have much to offer those requiring chrome-iron, chrome-nickel and nickel-chrome castings. Plenty of experience, skilled metallurgists and foundrymen, modern testing and analytical facilities, and one of the most up-to-date and fully equipped high alloy foundries in the country.

We'll be glad to help (1) in the design of the part you need to produce the strongest casting and (2) to advise in the alloying elements to produce the most durable casting.

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News Digest

ence over new unrated orders requesting delivery in the third quarter.

How DMS Works

Under DMS, the Defense Dept. and the AEC will tell the National Production Authority how much of the three metals they need to accomplish their production and construction programs each quarter. The NPA will distribute these requirements among the metals producers, who will reserve the required portion of their output for defense orders.

Defense contractors and subcontractors will be allowed to use A through E program symbols to identify their orders for acceptance within the reserved amount at the mills. The same kind of authority, in the form of preference ratings, will be given defense contractors who need products and materials other than controlled materials to complete defense work.

Military and AEC orders, identified by defense program symbols A, B, C, D and E, will be carried out under DMS Regulations No. 1 (production) and No. 2 (construction). The symbol "D" is reserved by the NPA for special assistance to "defense connected projects" certified as such by the defense department or the AEC.

Channels Listed

Procedures for obtaining authority to use defense program symbols have been listed by the NPA as follows:

1. Manufacturers of Class A products for the A through E defense programs will receive authorized production schedules, allotment authority to purchase controlled materials, and preference rating authority for other materials. This will be done on the basis of information furnished by them on Form DMS-4A, a modified version of Form CMP-4A. Until the new forms have been distributed, contractors may use Form CMP-4A.

2. Manufacturers of Class B products who receive rated orders from customers engaged in the A through E programs will be authorized to self-assign the B-5 symbol to identify their purchases of controlled materials and other production materials needed to fill these rated orders. This means that all manufacturers of Class B products (those listed in the Official Class B

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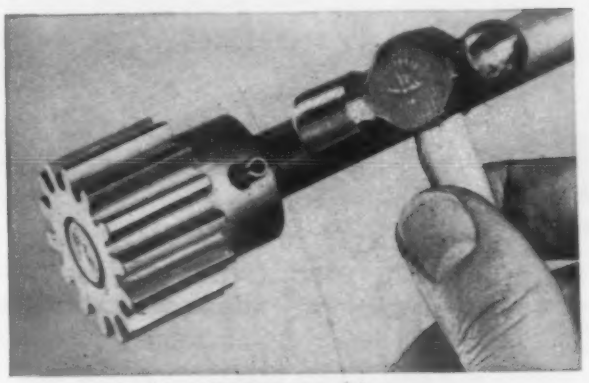
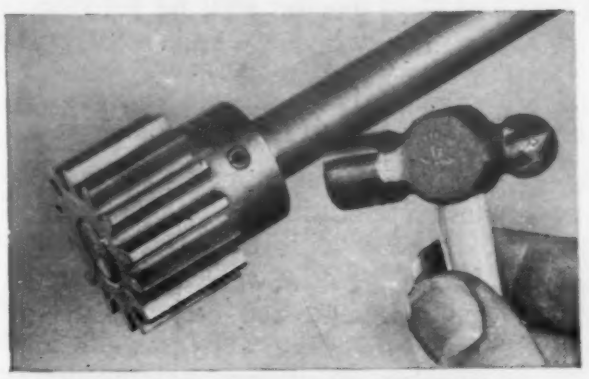
No threading, peening or precision drilling with ROLLPIN

Rollpin is driven into holes drilled to normal production-line tolerances.



It compresses as driven.



Rollpin fits flush . . . is vibration-proof.

Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

This modern fastener drives easily into standard holes, compressing as driven. Its spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. Rollpin is readily removable and can be re-used in the same hole.

* * *

If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—Rollpin can cut your costs. Mail our coupon for design information.

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Please send me the following free fastening information:

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☐ Elastic Stop Nut bulletin

☐ Here is a drawing of our product. What fastener would you suggest?

Name _____ *Title* _____

Firm _____

Street _____

City _____ *Zone* _____ *State* _____

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"ALODINE",® the new ACP protective coating chemical for aluminum, anchors the paint finish and protects the metal.

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"PERMADINE",® a zinc phosphate coating chemical, forms on steel an oil-adsorptive coating which bonds rust-inhibiting oils such as "Granoleum."

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The oiled "THERMOIL-GRANODINE" coating on pistons, piston rings, cranks, camshafts and other rubbing parts, allows safe break-in operation, eliminates metal-to-metal contact, maintains lubrication and reduces the danger of scuffing, scoring, galling, welding and tearing.

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"GRANODRAW"® forms on pickled surfaces a tightly-bound adherent, zinc-iron phosphate coating which facilitates the cold mechanical deformation of steel, improves drawing, and lengthens die life.

Send for descriptive folders and Government specifications chart on the above chemicals. Write or call for more information on these products, and advice on your own metal-working problem.

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News Digest

Product List) no longer will be required to file applications for controlled materials. Form CMP-4B, formerly used for this purpose, has been discontinued.

3. Construction for defense also will be identified by the A through E program symbols. Authorizations and related allotments will be made on the basis of information furnished by the applicants on Form DMS-4C, which is a modified version of Form CMP-4C. Until the new forms have been distributed, contractors may use Form CMP-4C.

4. Manufacturers of Class A and B products who are unable to obtain supplies for maintenance, repair and operating purposes needed to fill rated orders are permitted under DMS to self-authorized orders to obtain them.

Big Welding Show Set for Houston

The American Welding Society will hold its National Spring Meeting June 16 to 19 in Houston, Tex. Running concurrently with the technical sessions will be an exposition of the latest developments in welding and allied processes at the Shamrock Hotel Hall of Exhibits.

Two sessions will be held on the welding, brazing and soldering of titanium. Also of special interest is a two-part symposium on resistance welding which will cover instrumentation, techniques, quality control and applications.

About 70 manufacturers who sell products to the welding industry will be represented in the first all-welding show. Products for welded fabrication, weldments, welding processing, gas cutting, brazing, finishing, tooling, gaging, testing, stress relieving, x-raying, servicing and handling will be exhibited and demonstrated.

The technical program follows:

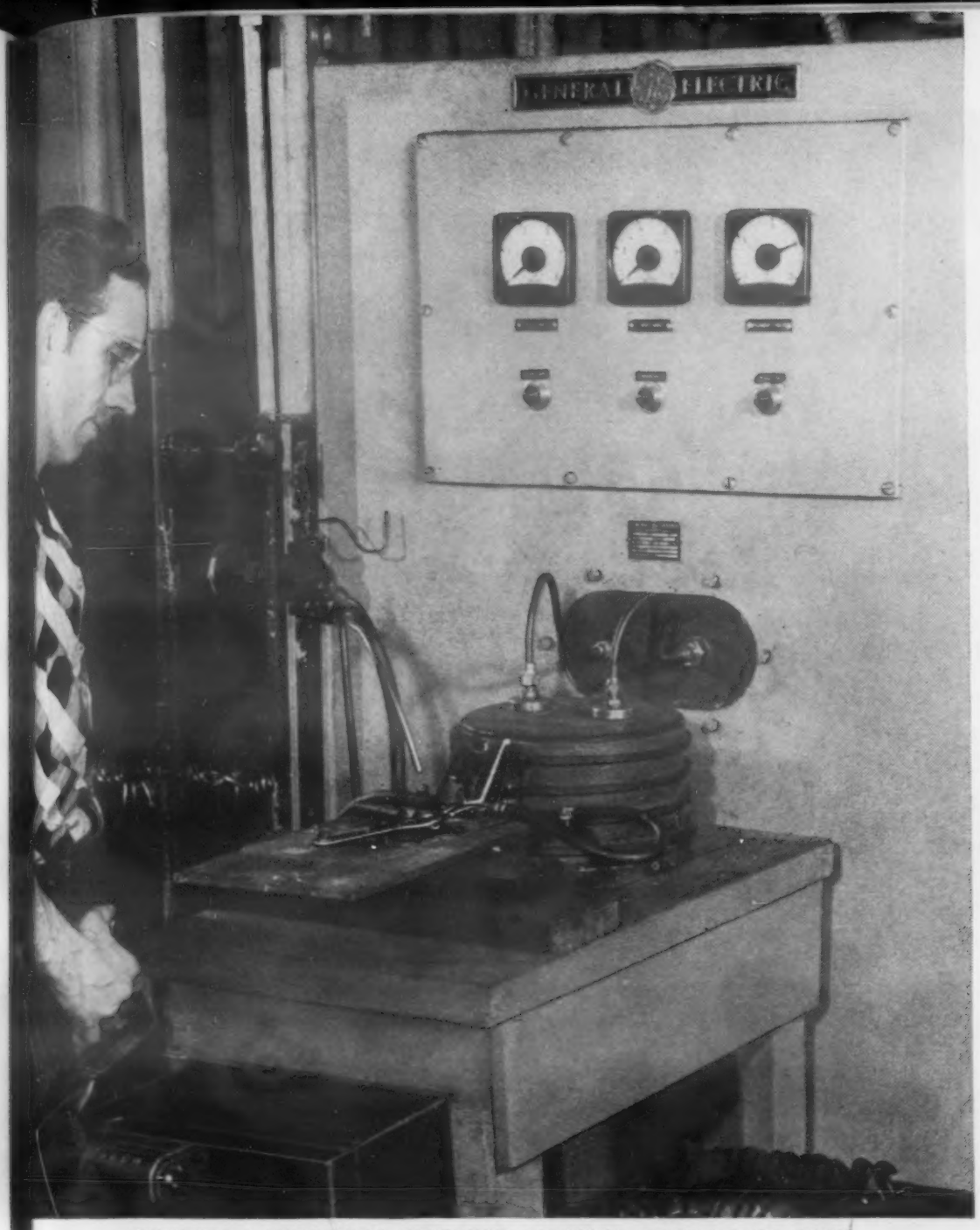
Tuesday Morning, June 16

(Two simultaneous sessions)

Welding Titanium

Effect of Atmospheric Contaminants on Arc Welds in Titanium. J. C. Barrett and I. R. Lane, Jr., U. S. Bureau of Mines.

The Effects of Iron, Manganese, Chromium and Molybdenum on



INDUCTION HARDENING WRENCHES AT UTICA DROP FORGE CORP.

Wrench Life Increased Ten Times With G-E Induction Heaters

"By induction-hardening working surfaces with G-E induction heaters, we are now making wrenches and pliers that last ten times longer," says Maynard Gray, Foreman, Heat Treating Dept., Tool Division, Utica Drop Forge & Tool Corp., Utica, N. Y.

Utica has found they can heat treat *only* the areas to be extra hardened —leaving the internal structure of the tool unchanged and preserving the desirable toughness necessary to withstand stress and shock.

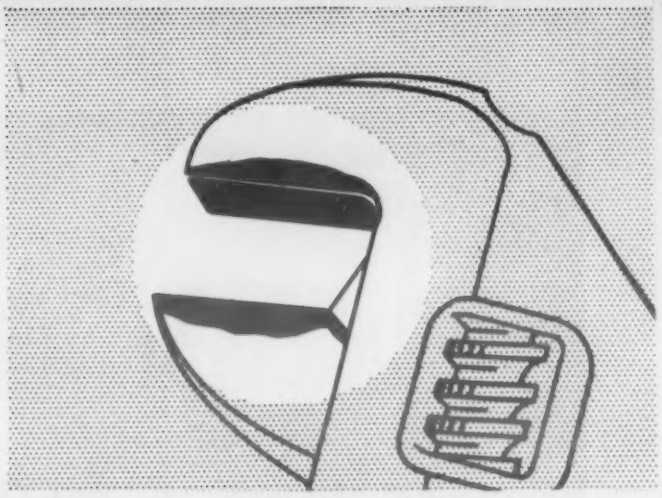
Lower labor costs and increased production are other benefits of G-E induction heating. At Utica one operator induction hardens 350 wrenches per hour or almost six per minute! In each case the tool is put on a special jig, heated, then immediately cooled by a jet of air.

Hardening is only one of many uses for G-E induction heaters. Other equally important applications are annealing, soft-soldering, brazing, and other jobs where it is necessary to localize the heating of parts. You'll find G.E.'s complete line of induction heaters can help you to accomplish your heating in the fastest, cleanest, and most economical way.

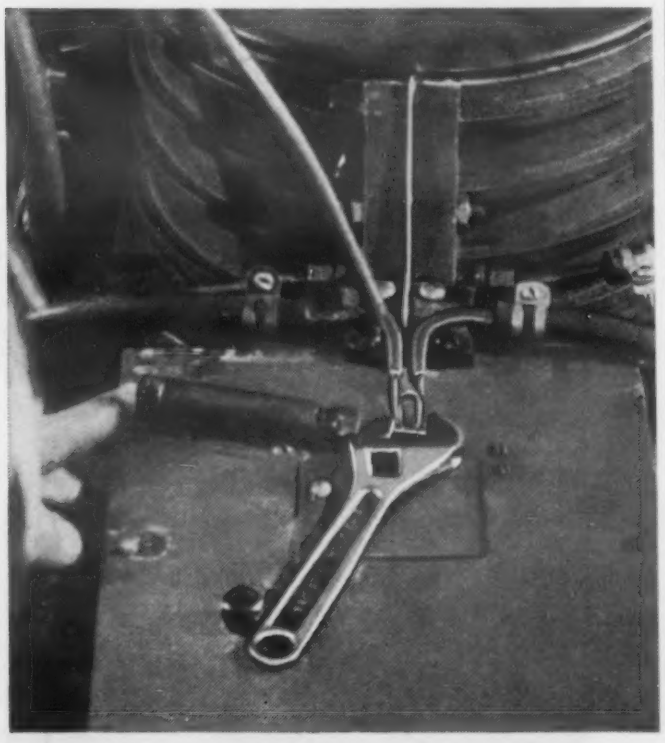
For more information on how induction heating can save you time and money contact your Apparatus Sales representative. And write now for bulletins on G-E induction heaters to General Electric Co., Sect. 720-104, Schenectady 5, N. Y.

You can put your confidence in—

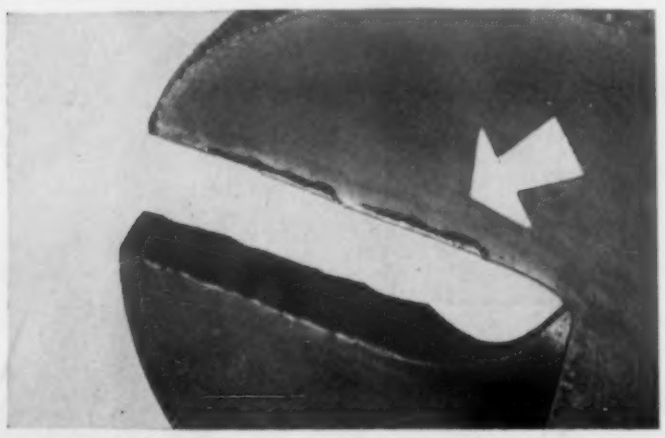
GENERAL ELECTRIC



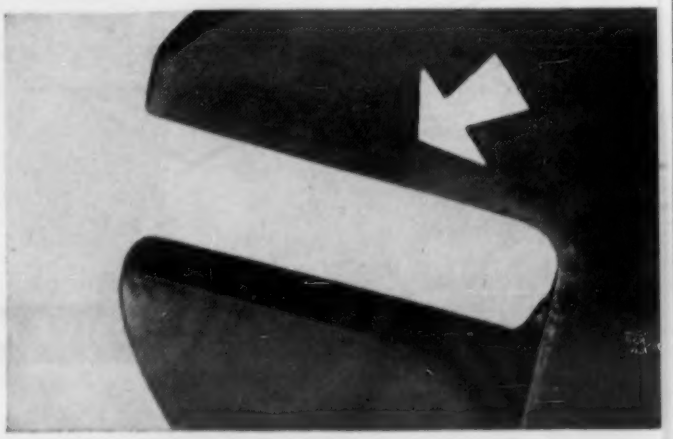
DARK AREAS SHOW where wrench-jaw surfaces are extra-hardened selectively by induction heat to resist burring and nicking.



SELECTIVE HEATING with G-E heaters is a fast process. With this special fixture, heating and cooling cycle takes only 10 seconds.



WITHOUT INDUCTION HARDENING wrench had tendency to wear or burr-over on the jaw surfaces after a given number of applications.



WITH INDUCTION HARDENING this same type wrench showed no burring or other wear when given 17 times the number of applications.

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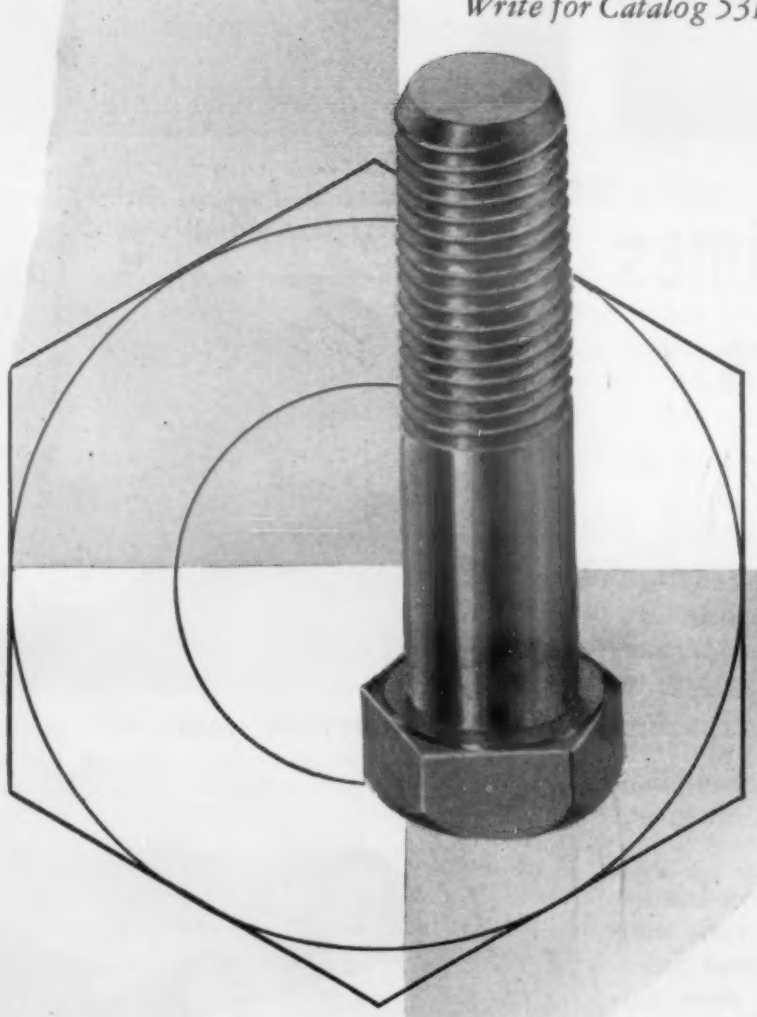

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Castleton-on-Hudson

New York

News Digest

Welds in Titanium. G. B. Grable, C. B. Voldrich and G. E. Faulkner, Battelle Memorial Institute.

Brazing of Titanium. J. M. Parks and N. A. Dececco, Armour Research Foundation.

Human Element in Welding

Human Elements and Problems in Welding. David P. O'Connor, Dept. of Water and Power, City of Los Angeles.

Human Element in Welding. R. C. Wiley, California State Polytechnic College.

Tuesday Afternoon, June 16

(Two simultaneous sessions)

Welding Titanium

Brazing or Soldering Titanium without Flux. Harlan L. Meredith, North American Aviation Co.

Restoration of Ductility in Alloy Titanium Welds. Allan J. Rosenberg, E. Hutchinson and S. Weiss, General Electric Co.

Spot Welding of Titanium-Carbon Alloys. E. F. Hold and N. L. McClymonds, P. R. Mallory and Co., Inc.; F. H. Vandenburgh, Mallory-Sharon Titanium Corp.

Resistance Welding

Flash and Pressure Weld Qualification Tests on 4340 Steel Heat Treated to 260- to 280,000 Psi after Welding. Mario L. Ochieano, Lockheed Aircraft Corp.

Basis for a Resistance Welding Specification for the Electronic Industry. Peter G. Poetto, CBC Welding Corp.; Stephen A. Montanaro and Harold Sharney, City Testing and Research Laboratory

Wednesday Morning, June 17

(Three simultaneous sessions)

Resistance Welding Symposium

I Instrumentation

II Techniques and Welding Schedules (continued in afternoon)

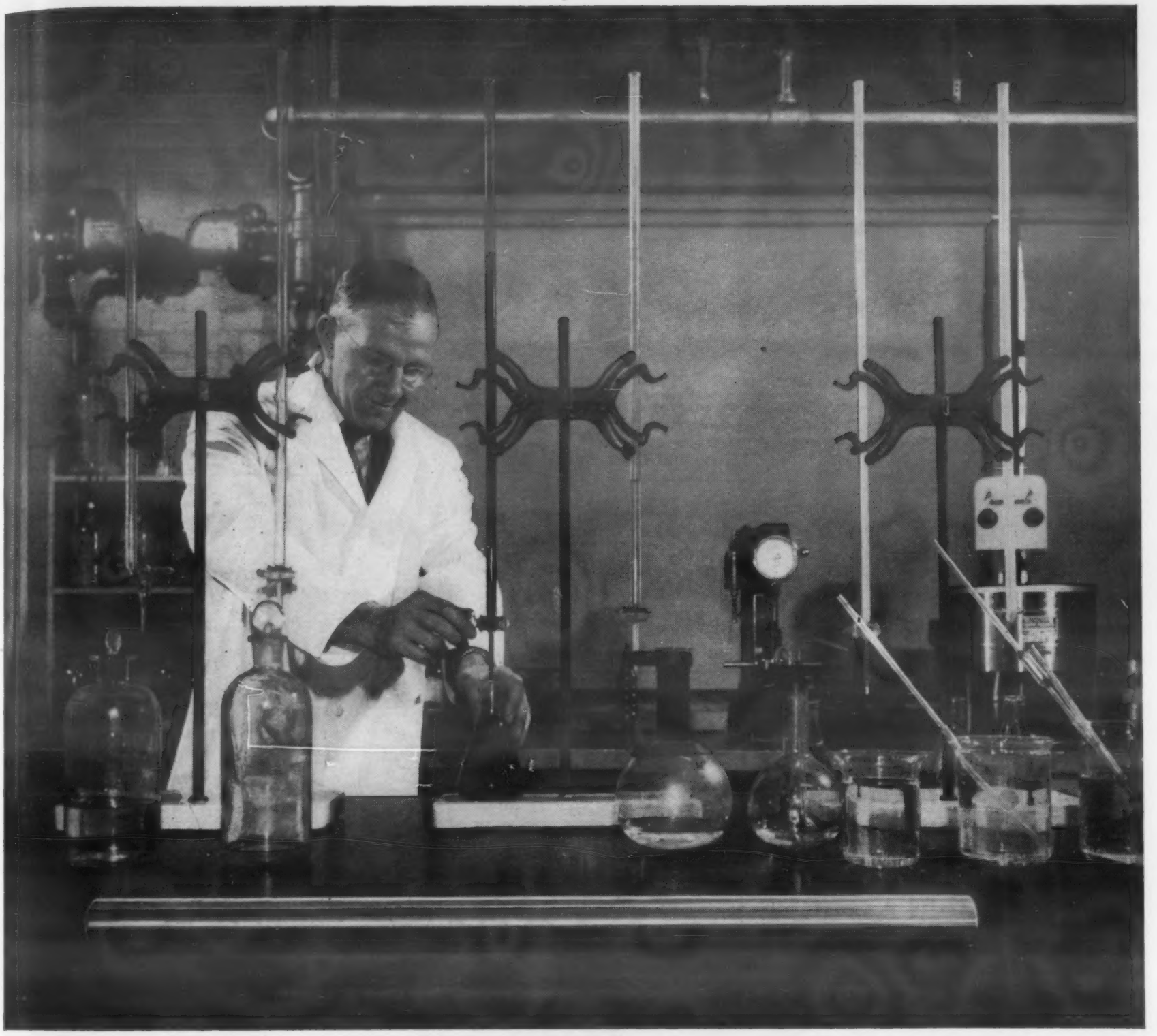
Inert Arc Welding

Inert Arc Welding without a Backing Strip. H. S. Blumberg, M. W. Kellogg Co.

Heliarc Welding of Stainless Steel Piping. F. J. Pilia, Linde Air Products Co.

Aluminum

Recrystallization Welding. John



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Columbia alloy bars have muscle—and plenty of it. It's the kind of uniform strength that our many customers have learned to rely on, because each alloy bar is made to the same exacting standards as the last.

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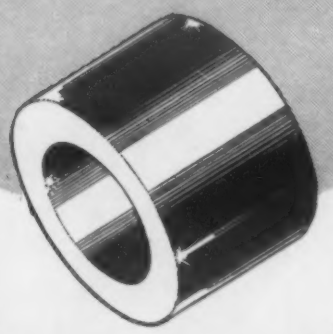

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News Digest

M. Parks, Armour Research Foundation.

Joining Aluminum to Other Metals. Mike A. Miller, Aluminum Research Laboratories

Some Consideration on Weldability of Aluminum Alloys. J. Koziarski, Piasecki Helicopter Corp.

Wednesday Afternoon, June 17

(Three simultaneous sessions)

Resistance Welding Symposium

III Production Quality Control
IV Applications
A Stainless Steel Aircraft
B Aluminum Aircraft

Structural Welding

Welded Rigid Connections for Portal Frames. A. A. Toprac, University of Texas

An Evaluation of Plastic Analysis as Applied to Structural Design. B. G. Johnston, University of Michigan; C. H. Yang and L. S. Beedle, Lehigh University

Plastic Strength and Deflection of Continuous Beams. K. E. Knudsen, C. H. Yang and L. S. Beedle, Lehigh University; and B. G. Johnston, University of Michigan.

Applications of Plastic Theory. W. S. Atkins, College of Technology, Liverpool

Inert-Arc Welding

Inert-Arc Welding by the Filler-arc Process. R. W. Tuthill, General Electric Co.

Stranded Electrode Materials for Aircomatic Welding. H. Robinson, Kaiser Aluminum and Chemical Sales Co., and H. C. Cook, Air Reduction Laboratory

Fusion Welding of Light-Gauge Alloys. Jack T. Maloney, Rohr Aircraft Corp.

Thursday Morning, June 18

(Two simultaneous sessions)

Storage Tanks and Pipe Lines

Automatic Field Welding of Girth Seams of Large Storage Tanks. Perry C. Arnold, Chicago Bridge and Iron Co.

Impact Strength of Arc Welds at

STEEL Tubing

Boiler and Pressure Tubes — Seamless or Welded
—
Mechanical Tubing
—
Stainless Pipe and Tubing
—
Small Diameter Tubing
—
Pipe and Tube Fittings — Welding or Screw Type
—
Large Diameter Pipe and Tubing

PROMPT DELIVERY FROM STOCK

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ESTABLISHED 1843
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Faster! Surer! Saves Money!

You're 'way ahead of the game with RB&W's unique new SPIN-LOCK Screw—it saves you money right down the line with its exclusive *one-piece* construction. Here's why:

Workers do more fastening in less time. There's no washer to add. And it's easy to drive SPIN-LOCK in hard-to-reach spots.

Purchasing and inventory costs drop. There's just one requisition to fill . . . one part to stock, because SPIN-LOCK does away with the need for washers.

Accidents and lost time go down. There's no projection on SPIN-LOCK to catch fingers or clothes. No special handling is required, either.

SPIN-LOCK holds tighter under vibration than ordinary fasteners. Ratchet-like teeth under the head lock into the surface when assembled. Hex, pan, truss, flat heads.

Teeth of SPIN-LOCK Screw touch bearing surface before final tightening.

Final tightening embeds teeth in surface, assuring positive locking.

Write to Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y., for free booklet containing complete data and specifications on the SPIN-LOCK Screw.

RB&W—The Complete Quality Line. *Plants at:* Port Chester, N.Y., Coraopolis, Pa., Rock Falls, Ill., Los Angeles, Calif. *Additional sales offices at:* Philadelphia, Pittsburgh, Detroit, Chicago, Dallas, San Francisco. *Sales agents:* Portland, Seattle. Distributors from coast to coast.

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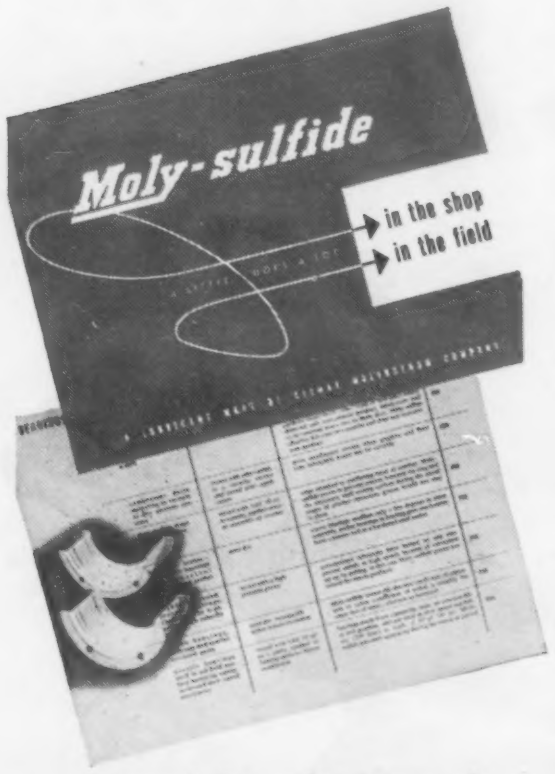

154 varied applications of molybdenum sulfide in the shop and in the field are described in a new booklet now available. This solid-film lubricant has demonstrated unique anti-friction properties under conditions of extreme pressure, high velocity, elevated temperature, or chemical attack.

The 40-page booklet contains the records of solved lubrication problems — some might solve your own.

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News Digest

Low Temperatures. J. R. Watt and J. J. Smetana, University of Texas

The Use of Magnaflux for Quality Control of Pipe Line Welds. George L. C. Dehn, Magnaflux Corp.

Stainless and Alloy Steels

Stabilizing Austenitic Chrome-Nickel Weld Metal Against Intergranular Corrosion. H. C. Campbell, Arcos Corp.

Submerged-Arc Welded Vessel Linings. James G. Kerr, C. F. Braun and Co.

Applications of Medium Alloy, High-Strength Steel in Welded Construction. Howard L. Miller, Republic Steel Corp., and Arthur E. Wilkoff, Youngstown Steel Car Co.

Friday Morning, June 19
(Two simultaneous sessions)

Arc Welding Applications

Arc Welding of Ferritic and Austenitic Nodular Cast Iron. Harry Fisk, Jesse S. Sohn and Willard M. Boam, Wright Aeronautical Div., Curtiss Wright Corp.

Fusion Welding of Ductile Iron. T. E. Kihlgren and H. C. Waugh, International Nickel Co., Inc.

Maintenance Welding in the Petroleum Industry. Don H. Rasmussen, Eutectic Welding Alloys Corp.

Marine Structures

Tricky Problems in Welded Ship Repair. Milton Forman, Todd Shipyards Corp.

Residual Stresses in Welds. Bela Ronay, U. S. Naval Engineering Experiment Station

Ceramic Improves Navy Device

Use of barium titanate, a relatively new ceramic, has enabled the Naval Ordnance Laboratory to build a smaller transducer that is simpler, cheaper and acoustically better than older ones.

The scanning transducer is an electronic element used in complex ordnance devices. Mosaics of quartz or Rochelle salt crystals, formerly used, had to be mounted on curved surfaces to give the type of elec-

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125	275	450	1000	1550
138	288	500	1050	1600
150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
238	388	900	1450	2000
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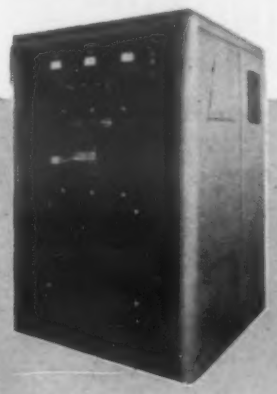
DEPT. OF DEFENSE work . . . by *LINDBERG* Induction Heating Units



L. A. Young Spring & Wire Corp., Detroit, Mich., use two 5 KW Lindberg Induction Heating Units for production brazing, soldering, hardening, annealing, stress relieving, hot forming, forging or shrink fitting requirements.

We can't tell you much about the manufacturing processes at the L. A. Young plant (due to security restrictions) . . . but we can tell you about the many rugged construction features of this equipment . . . features which make it so dependable that the L. A. Young organization selected Lindberg Induction Heating Units for their important Department of Defense work. These points of design and construction will minimize costly breakdowns and aggravating work stoppages:

Filament voltage regulation transformers keep tube filament voltages at proper values regardless of line fluctuations. The end result . . . longer tube life.

Checklites . . . A system of indicating lamps instantly reveals any abnormal operating conditions . . . simplifies servicing.

Work coil burn-out protection . . . An electrical interlock system makes it impossible to turn on power when cooling water is not flowing.

Long-life industrial tubes feature shortened internal structure . . . Kovar metal-to-glass Seals . . . heavy walled anodes.

Sealed tank capacitors are hermetically sealed against dirt and dust . . . require no servicing or refilling.

Investigate Lindberg Induction Heating Units. Ask for Bulletin 1440.

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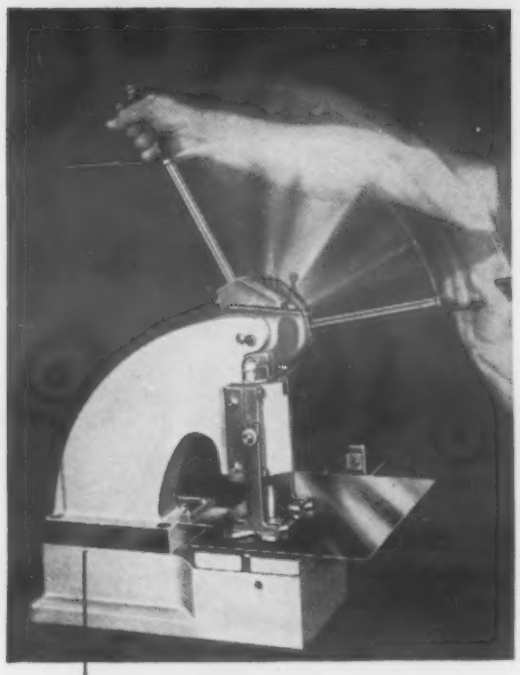

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Deep throats—6 and 12 inches—of Di-Acro Punch Presses make them ideal for many operations impossible to perform on most bench presses.

Holes of various shapes and sizes—as large as 4" in diameter in 16 gauge steel—can be punched. Vee shaped ram controls position of punch head assuring perfect alignment. Turret stripper, of exclusive Di-Acro design, strips material from punches of all shapes. Side and back gauges provide exact work positioning.

*pronounced Die-ack-ro

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Complete line of standard size punches in round, square, notcher, rectangular and oval shapes available in six clearances. Also special sizes.

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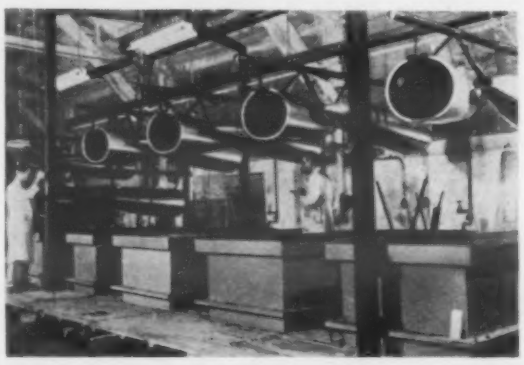
di-acro PRECISION METALWORKING MACHINES

News Digest

tronic pattern needed. Construction costs were high, and performance at high frequencies was unsatisfactory.

The advent of commercially available barium titanate ceramics opened up new possibilities, since the piezoelectric material could be manufactured in any desired shape. The shape finally developed by A. L. Lane, of the Underwater Ordnance Dept., is a small shell about 1/2-in. in dia and weighs only 1/16 oz.



Mechanized Corrosion Prevention Production of jettisonable fuel tanks by Pastushin Aviation Corp. is speeded by a unique conveyor dipping line which immerses tank parts in five different baths making up an Alodine 600 coating sequence. The aluminum parts are cleaned, rinsed, coated with Alodine 600, rinsed again, acid rinsed, then dried by convection currents—all in 5 min.

Electroplaters Set June Program

A symposium on chromium plating and a special evening question period will highlight technical activities at the 40th annual meeting of the American Electroplaters' Society in Philadelphia, to be held June 15 through 18.

A full round of social activities, including an open house, banquet, dance and golf, will supplement the technical program. An event-packed ladies' program is also planned. Headquarters for the meeting will be

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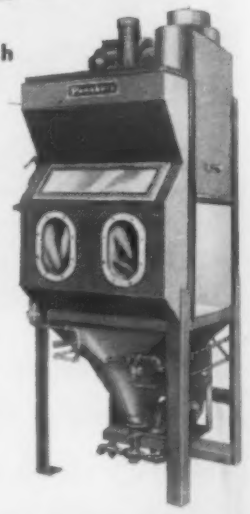

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Remington Rand Methods News

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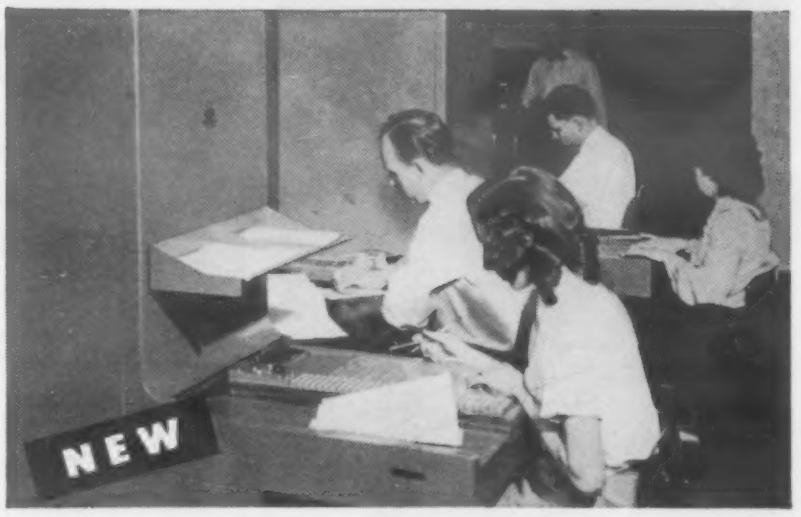
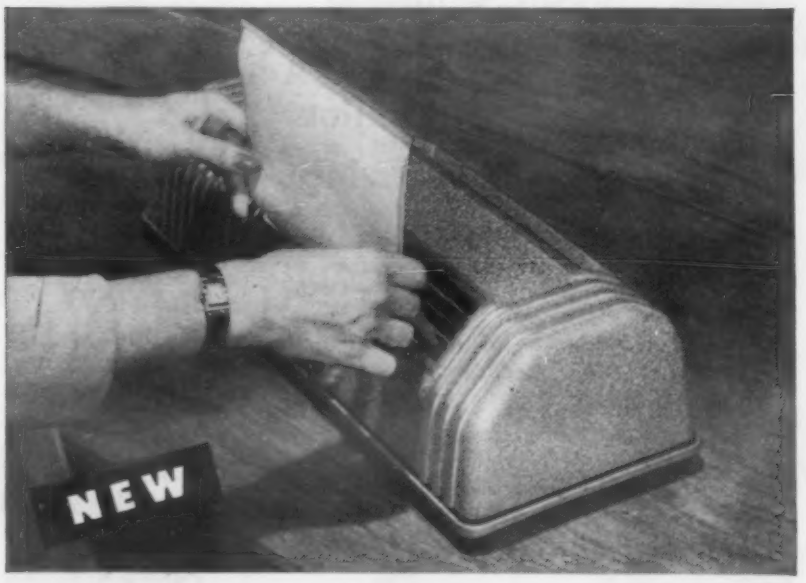
Brings a punch TO the punched-card file. *Card-o-Matic* is a brand-new, labor-saving approach to punched-card billing, inventory control and sales analysis; also for punched-card preparation of orders, shipping labels, parts lists, payrolls, vouchers, etc. Located at the Convé-Filer (or ordinary tub file), this remote-control sensing unit reproduces all desired information from master punched cards. Variable information is entered directly from its keyboard. New detail cards are completed automatically on the Card-o-Matic Punch. For more information, see folder **TM-822.**



Brings the visible records TO the clerk. *Robot-Kardex* already saves clerical time for many firms on inventory control, production control and other operating records. Along with the many advantages of Kardex *visible-control* methods, it also provides the *plus* of push-button, mechanized delivery of the records to comfortable, desk-level position. Delivers any Kardex slide in four seconds average. See booklet **KD-505.**



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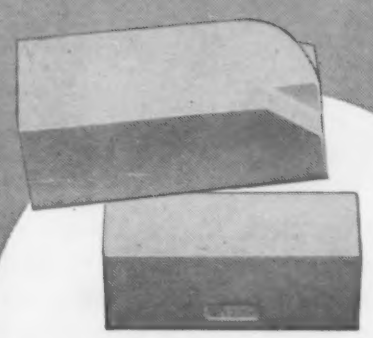

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The technical program follows:

Monday, June 15, 2 p.m.

BRIGHT GOLD PLATING. Edwin C. Rinker, Sel-Rex Precious Metals, Inc.

STATISTICAL QUALITY CONTROL—A New Tool for the Electroplater. Ezra A. Blount, Products Finishing.

A CORROSION STUDY OF VARIOUS CHROMIUM-PLATED ELECTRODEPOSITS. Henry Brown and Edwin Hoover, Udylite Corp.

IRON PLATING FROM AN ALKALINE BATH. Edward Foley, Jr., Henry B. Linford, Columbia University, and Walter Meyer, Enthone, Inc.

Tuesday, June 16, 9 a.m.

BLACK CHROMIUM - BASE ELECTROPLATING. Martin Quaely, Westinghouse Corp.

CRACK FREE CHROMIUM—A NEW PROCESS. R. Dow and J. E. Stareck, United Chromium, Inc.

COST DETERMINATION IN THE INDUSTRIAL CHROMIUM PLATING JOB SHOP. W. F. Walton and P. B. Lonsbury.

STABILITY OF ION EXCHANGE RESINS TOWARD CHROMIC ACID PLATING.

SOLUTIONS. C. Frederick Paulson, Permutit Co.

Tuesday, June 16, 2 p.m.

A STUDY OF CYANIDE DECOMPOSITION. E. J. Serfass and R. F. Muraca, Lehigh University, and Walter Meyer, Enthone, Inc.

EVALUATION OF CARBONATE REMOVAL METHODS. R. Scott Modjeska, Scientific Control Laboratories.

A FURTHER STUDY OF THE EFFECT OF ABRASIVE METAL POLISHING ON THE CHARACTER OF NICKEL PLATE. W. L. Pinner, Houdaille-Hershey Corp.

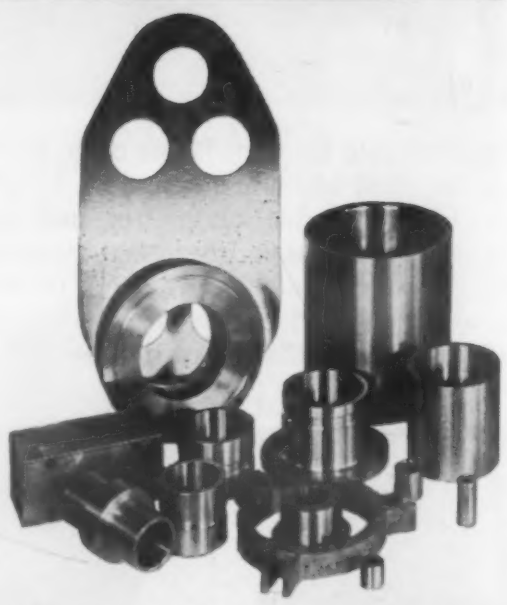
PLATING ON MOLYBDENUM. A. Korbelak, *Plating*.

Wednesday, June 17, 9 a.m.

AN ELECTRONIC THICKNESS GAGE. Abner Brenner, National Bureau of Standards.

THICKNESS OF ELECTRODEPOSITS BY THE ANODIC SOLUTION METHOD. C. F. Waite, King-Seeley Corp.

(*Continued on page 279*)



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TESTING ORGANIC FINISHES AND INTERPRETATION OF RESULTS. C. O. Hutchinson, The Glidden Co.

Thursday, June 18, 9 a.m.

A.E.S. Research Session.

The question and answer period will be held Tuesday, June 16, at 8:30 p.m. Dr. Abner Brenner of the National Bureau of Standards will be moderator, and the authors listed above will make up the panel.

Aircraft Engineers Split on Presses

Aircraft production men are still split on the value of the heavy press program. They aired their differences several weeks ago in a panel discussion on "large forgings and castings" in New York City. The panel was part of a week-long Aeronautic Production Forum sponsored by the Society of Automotive Engineers.

Extrusion presses ranging from 8000 to 20,000 tons will be ready to operate this year, and forging presses of 25,000- to 50,000-ton capacity will be ready in 1954. But some engineers did not seem overly impressed.

One of the difficulties brought out was the quality and cost of tooling. Present dies are sunk in solid forged blocks of steel and are thought to be imperfect. A set of such dies is estimated to cost about $300,000, and there was some debate on whether such a cost could be amortized. Cast dies would save little unless they could be poured to close tolerances, which does not seem possible now. Built-up and laminated dies are being studied but have not yet been produced.

It was also pointed out that for best results the dies should be heated to 800 F to handle aluminum alloys. Such a temperature will make it hard to maintain tolerances, particularly if uniform die temperatures cannot be held.

Discussion brought out the fact that few orders for large sections are now on the books. One speaker

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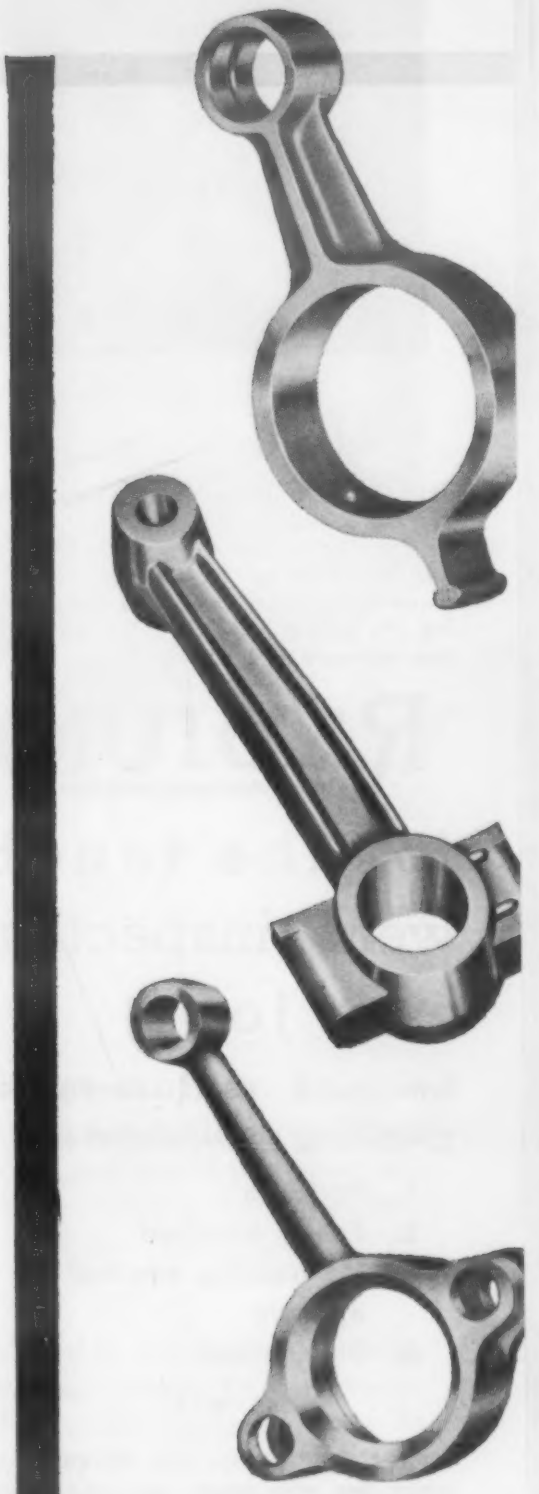

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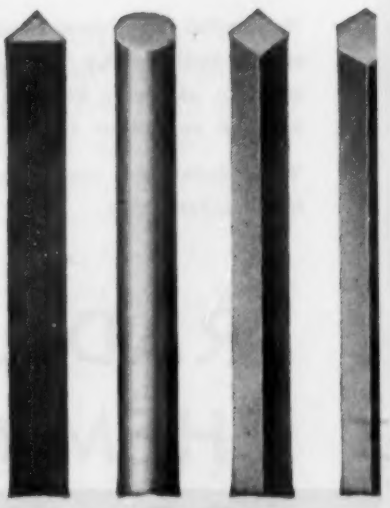

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said it would take more than a year to get a part from design to production, and it looked as though the aircraft manufacturers had not yet started to design for the large sections. Representatives of companies operating large presses said they would use the heavy presses to handle overflow from their lighter presses while waiting for orders.

Supporters of the heavy press program pointed to a part now in production as a single forging previously assembled from 37 separate pieces. Newspapers and journals in general were severely criticized for "misleading statements" about the program.

Gloss Tests: Fewer or More?

Despite the best efforts of glossimetry, it looks like the engineer will have to be content with inexact words like "mirror-like", "semi-bright" and "matte" for some time yet.

"Glossimetry", for the unitiated, is the measurement of gloss or surface reflectance of light, and it's pretty complicated. Just how complicated was indicated by the symposium on the subject sponsored by ASTM Committee E-12 on Appearance held during the Society's spring meeting.

At the present time there are a number of established gloss testing procedures. In general, they are not applicable to the same materials. Based on a study of the physics of surface reflection, however, H. K. Hammond and Daniel Smith believe that a single basic method for gloss measurement for all materials is within the realm of possibility.

A different conclusion was reached by Richard S. Hunter. Admitting that effective coordination might reduce slightly the present number of established gloss measurement procedures, he maintained, however, that no single method will ever serve all the needs of materials technology.

He pointed out that there are at present no established measurement procedures for several of the appearance criteria used for visual ratings of gloss. And new gloss testing pro-

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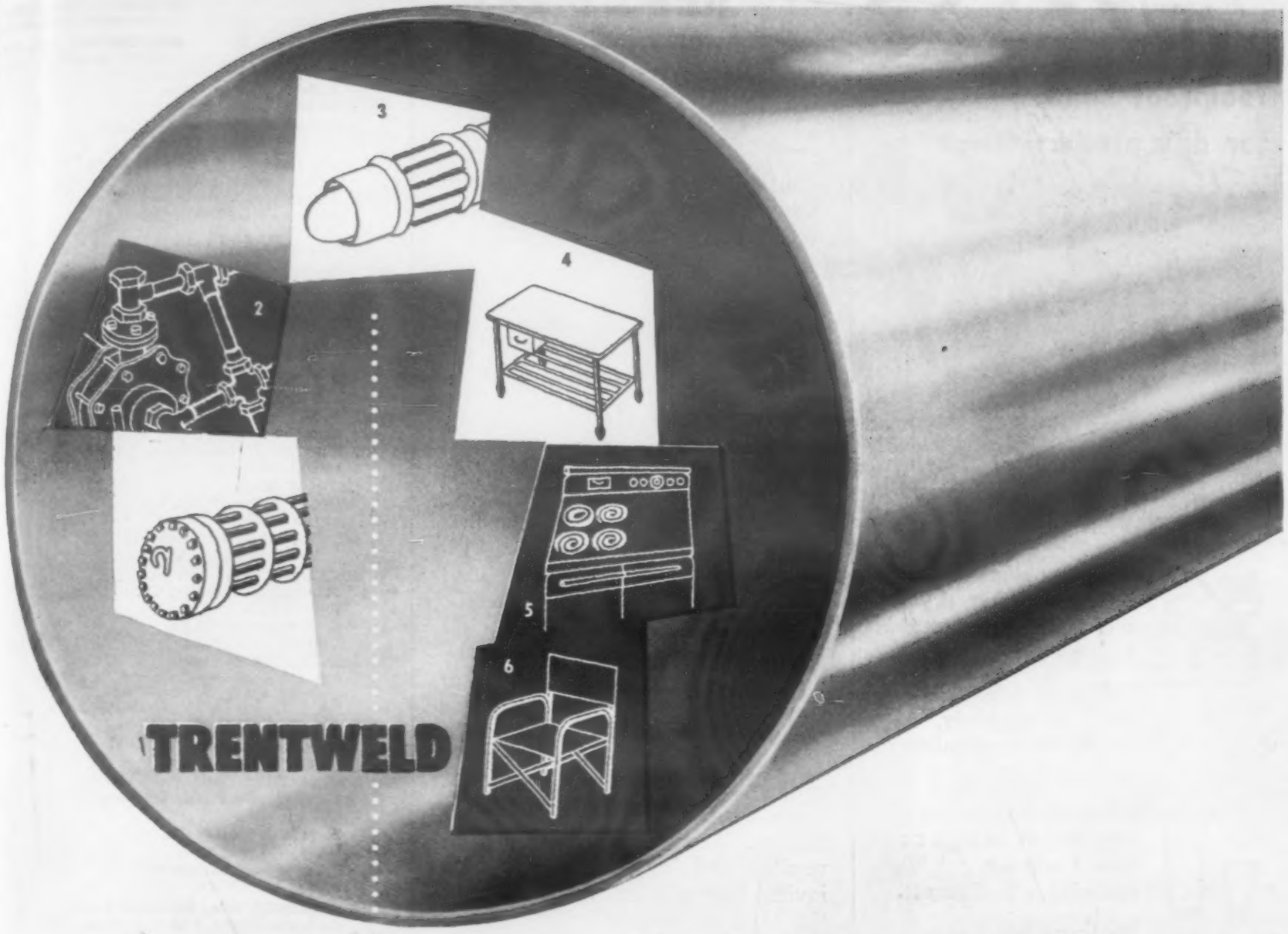

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cedures are needed for those criteria which at present cannot be measured.

"Therefore," he said, "the net trend in glossimetry will probably be toward more rather than fewer gloss testing procedures."

MIT to Hold Materials Courses

Special programs in Fundamentals of Physical Metallurgy and in Advanced Strength of Materials will be held this summer at Massachusetts Institute of Technology.

The course in fundamentals of physical metallurgy will be held from June 16 to 26. Professors Morris Cohen, M. B. Bever and B. L. Averbach, who will direct the program, say it will be an educational course, not a research conference. Lecturers from other universities and laboratories have been invited to supplement the teaching of the MIT faculty.

Basic Principles

"We expect to emphasize basic principles, and the general level of the program will be only moderately advanced," Prof. Cohen said. The general level of the lectures will be adjusted to the metallurgist who has not had graduate work or who has been out of school for several years. The program planners also feel the course may be useful to men trained in other sciences but now working with metals.

The course in advanced strength of materials will be given from July 6 to 17. It will be under the supervision of Dr. Jacob P. Den Hartog, and is planned particularly for stuctural engineers in industry and for teachers of engineering mechanics.

Round Table Talks

The course will consist primarily of a coordinated sequence of 30 lectures, with supplementary round table discussions and visits to MIT laboratories. According to Prof. Den Hartog, "The demands of modern technology for structures and machines of ever greater capacity, speed and efficiency call for designers equipped with a thorough understanding of the strength of materials. In the design of many modern structural elements advanced analytical

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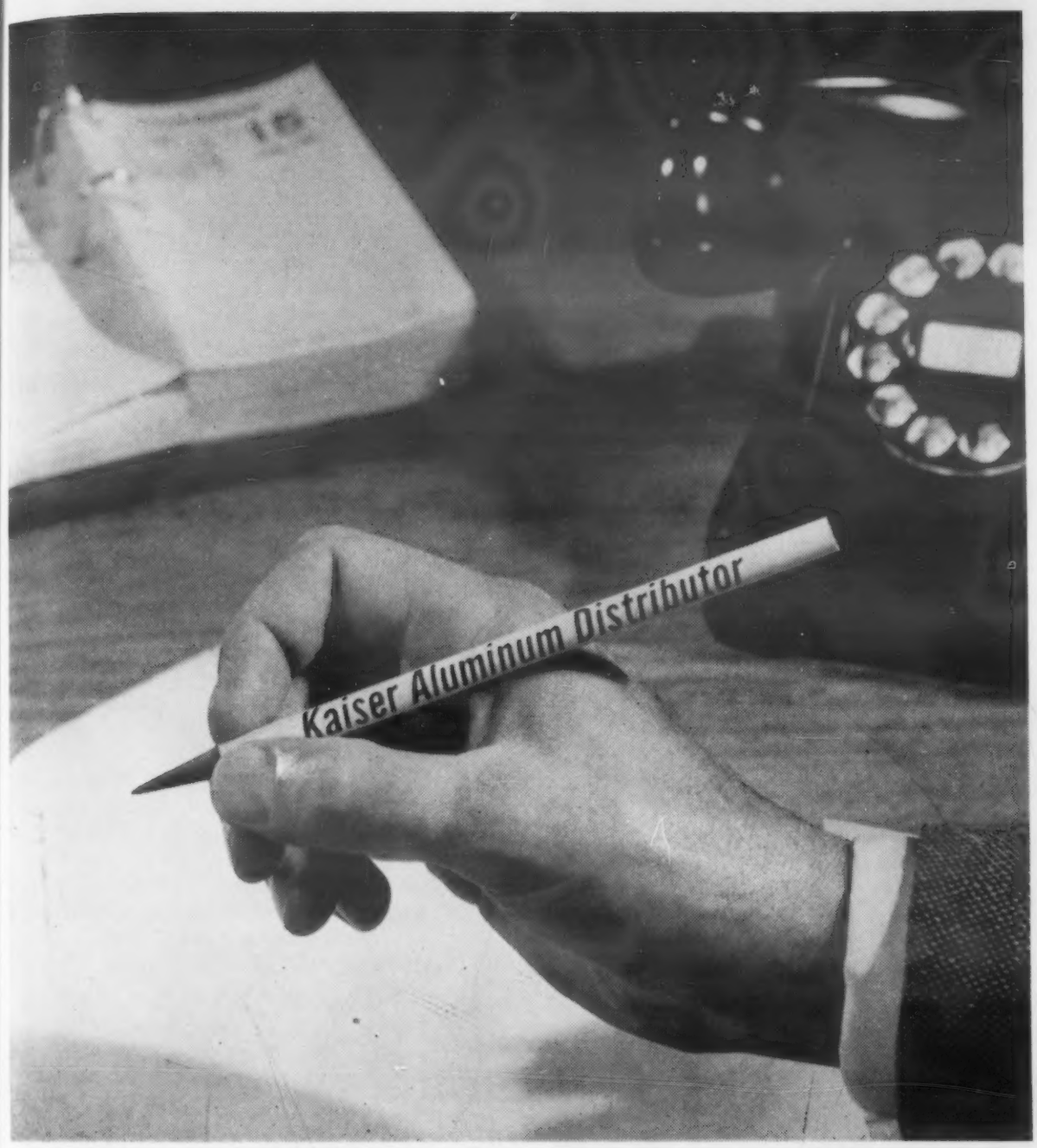

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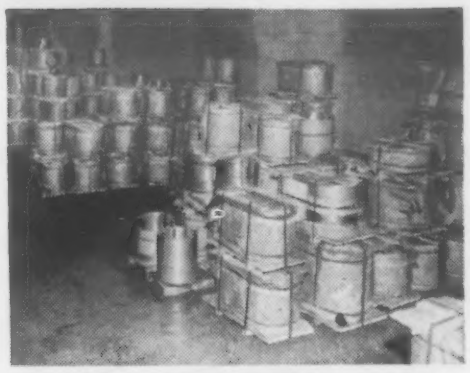

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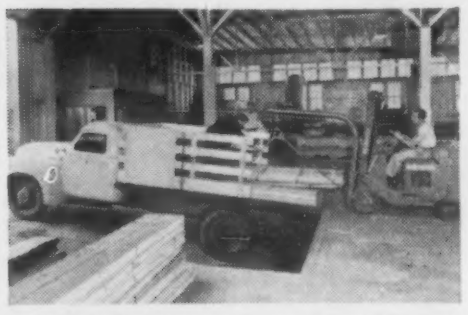

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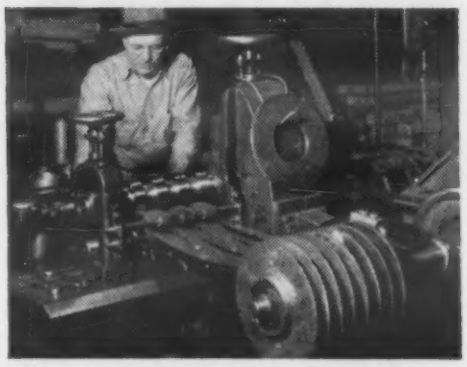

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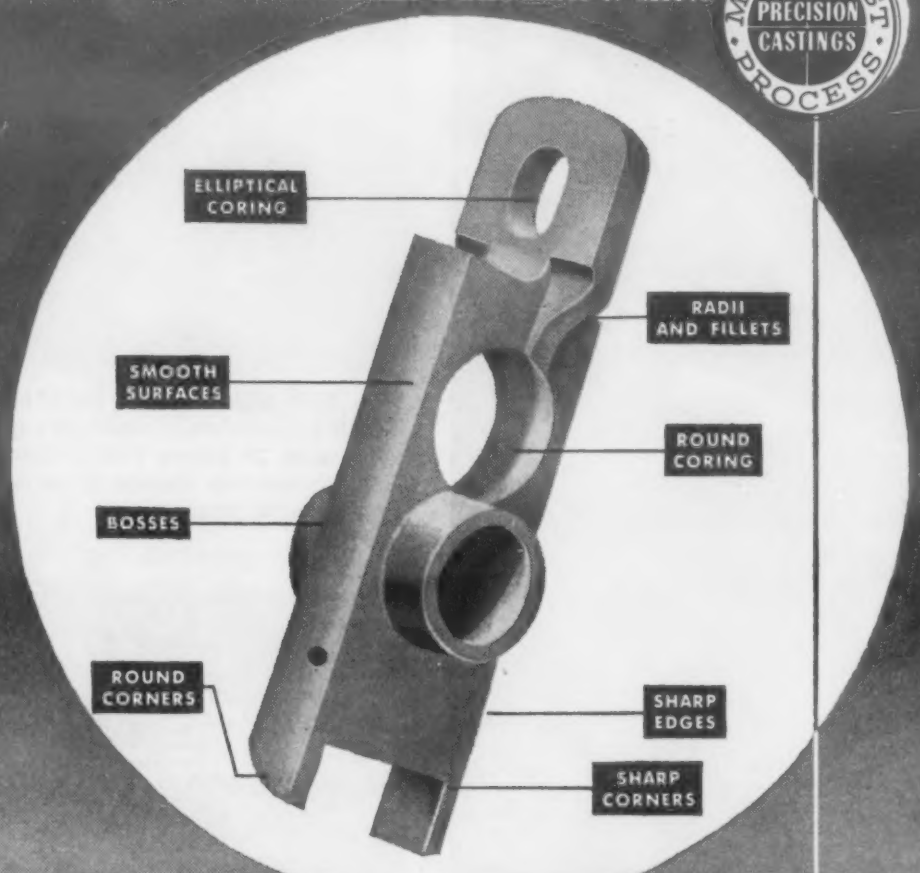

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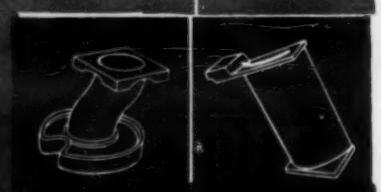
Design for little or no machining—for better parts at less cost—for longer life of parts, and for functional improvements from the use of better metals and alloys.

Microcast parts, as cast, are structurally sound, dimensionally uniform and smooth of surface.
Consider this advanced process in your product designing. Write for booklet explaining Microcast Process and uses . . . also information about new Microcast cabinet models.



MICROCAST DIVISION

austenal laboratories, inc.
224 East 39th St., New York 16, New York
7001 South Chicago Ave., Chicago 37, Ill.

News Digest

techniques are required as well as a proper appreciation of the effects of extreme stress and temperature conditions."

Further information and application forms for either program can be obtained from the Director of the Summer Session, Room 3-107, MIT, Cambridge 39, Mass.

News of Engineers

New additions to the Engineering Div., Midwest Research Institute, include: *Fred W. Whitlock,* senior project engineer, formerly with the Office, Chief of Ordnance; *Tom J. Love, Jr.,* mechanical engineer, previously with Colgate Palmolive Peet Co.; *John C. Lindholm,* mechanical engineer, formerly with General Electric; *Felix W. Fleming,* mechanical engineer, formerly with the Texas Co.; and *Robert C. Stultz,* electronics technician, previously with the Mercury Electric Co.

The Acheson Colloids Co. has announced three new executive appointments. *Harold J. Dawe,* director of product development, has been named technical director; *John W. Shier,* plant engineer, has been appointed production manager; *Earl L. Youse* has been named supervisor of the product development laboratory.

Thorbjorn Madsen, works manager of the Scale Div., John Chatillon & Sons, has been elected vice president in charge of production for the division.

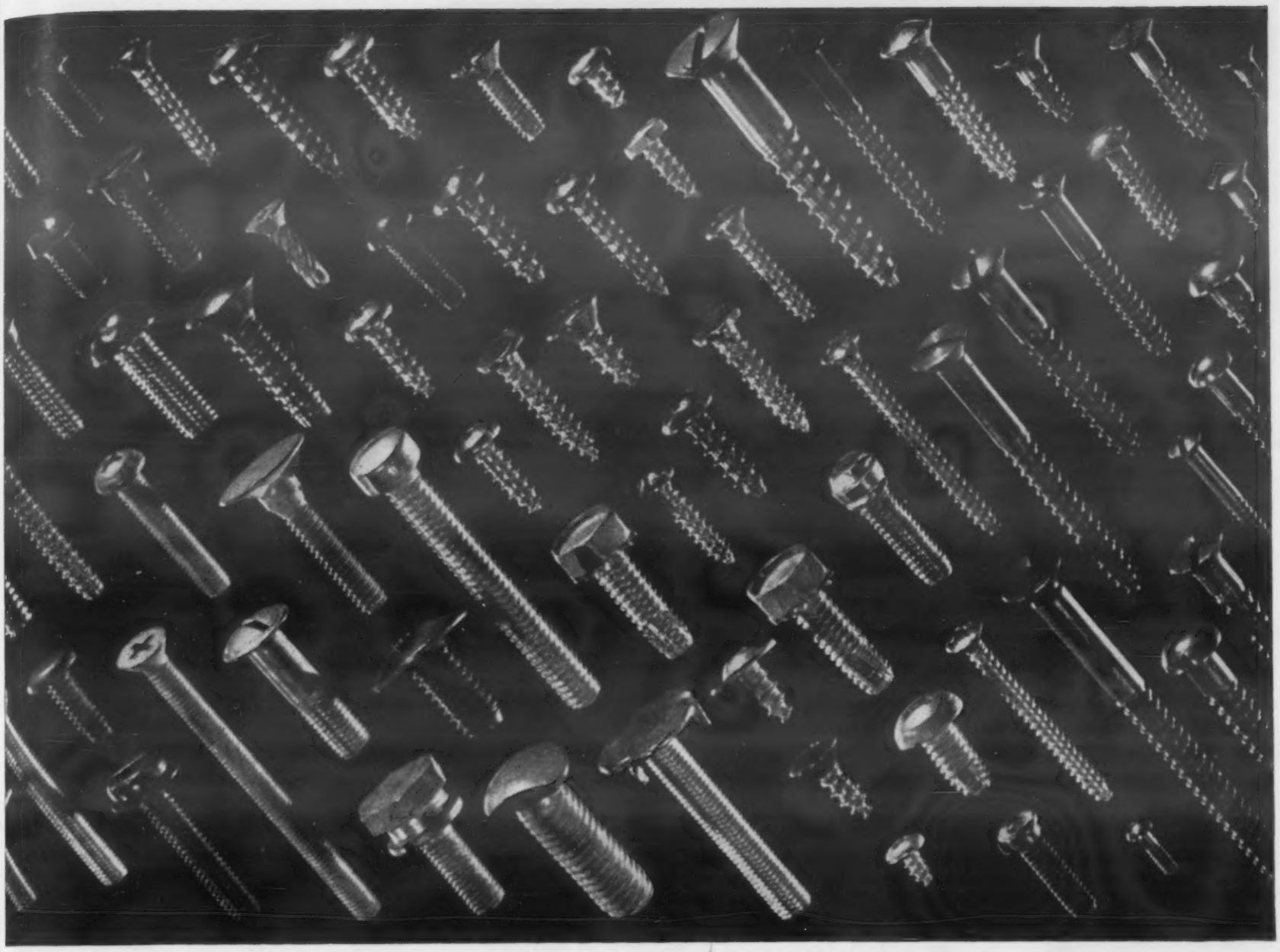
Dr. Leland M. White, head of the Rubber Applications Dept. at the Passaic, N. J., general laboratories of U. S. Rubber Co., has been appointed assistant director of research and development for the company. *Dr. B. C. Barton* will assume Dr. White's former post.

Oliver E. Rodgers has been named chief engineer of the Jet Engine Div., Packard Motor Car Co.

Laclede-Christy has announced the appointments of *Charles J. Guimbarda* and *James W. Bennett* as design engineers in its general office at St. Louis.

Fred K. Powell, Jr., vice president in charge of engineering, American Machine & Foundry Co., was presented a Missouri Honor Award for Distinguished Service in Engineering during a special convocation climaxing Engineers' Week at the University of Missouri.

M. Merle Harrod has been elected president of The Wapakoneta Machine Co., following the death of *Carl D. Fischer, Jr.* Mr. Harrod was formerly vice



Each Made From the Right Cold-Heading Wire

If you're cold-heading fasteners, you know how important it is to start with the right wire. With the right wire, you can produce the fastener economically, and at the same time make an item that will do its job right.

Bethlehem can help you improve your production of cold-headed fasteners by supplying wire with the required properties. Perhaps the wire you need must have good machinability. Or perhaps it must be of the right composition to respond to heat-treatment properly. Or be able to withstand severe cold-heading operations.

And of course all fasteners call for wire that is sound, uniform in analysis, and free from injurious surface defects. But whatever your requirements—for fasteners, or any other application—you can be sure that we can supply you with the wire that will help make your product better.

Bethlehem makes just about every kind of steel wire. Some are general-purpose grades; others, like screw wires, are tailor-made for a single application. If you make screws, or any other item by cold-heading, give us a call. We'll be glad to recommend the right kind of wire for your job.

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Bethlehem **COLD-HEADING WIRE**

BETHLEHEM STEEL

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Roto-Finish COMPOUNDS AND CHIPS ARE MADE TO GIVE YOU THE PROPER FINISH ECONOMICALLY

There are other brands of materials that resemble Roto-Finish chips and compounds . . . but only Roto-Finish chips and compounds give you the *extra advantage* of continuous research by the company who originated the Roto-Finish processes. Roto-Finish chips and compounds are carefully manufactured so *you* obtain the best results on *your specific job*. To obtain the best results at the lowest cost . . . insist on ROTO-FINISH chips and compounds.

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SAVES MAN HOURS AND MONEY by eliminating hand finishing.
GIVES ABSOLUTE UNIFORMITY...in any quantity.
MAINTAINS PRECISION TOLERANCES.
CUTS FINISHING costs as much as 80%.
LOWERS INITIAL and MAINTENANCE costs.

ROTO-FINISH COST-FREE ENGINEERING SERVICE GUARANTEES RESULTS

Put the experience and facilities of Roto-Finish to work for you on *your special finishing problems.*

Send a few unfinished parts to us . . . plus a finished part as a guide. We *guarantee* that you will get the same results in your plant that we produce in our laboratory. There's no obligation.

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News Digest

president of the company.

Election of *August B. Hoefer* as vice president of Udylite Corp., and as vice president and general manager of Frederic B. Stevens, Inc., a wholly owned subsidiary of Udylite Corp., has been announced.

Richard N. Mathews has been elected vice president of Kewanee-Ross of Canada Ltd., and placed in charge of the firm's new general offices in Toronto.

A testimonial dinner was recently given in honor of *Frank H. Mulligan* to celebrate the beginning of his 35th year with Charles Hardy, Inc.

Two executives of American Steel & Wire Div. have been promoted to new posts: *Richard R. Snow* has been named assistant to vice president of operations with headquarters in Cleveland, and *John P. Debri* has been named general superintendent of the Wire Div.'s Joliet plant. Mr. Debri succeeds Mr. Snow, who leaves his Joliet post to replace *Burton H. Gedge,* who is retiring after 42 years of service.

Les A. Shea, general sales manager, Lindberg Engineering Co., has returned after eight months in Washington as industrial representative in NPA. Mr. Shea now heads the expansion plans and moving of the company's Air & Hydraulic Div. to a new location.

John A. Deitrich has been elected president of Hind Steel Co., Inc.

Myron S. Curtis, director of engineering of the Warner & Swasey Co., has been elected engineering vice president.

Albert B. Diss has been appointed vice president and general manager, The Watson-Stillman Co., division of H. K. Porter Co.

Louis W. Davis was elected president and general manager of Metal Hydrides Inc.

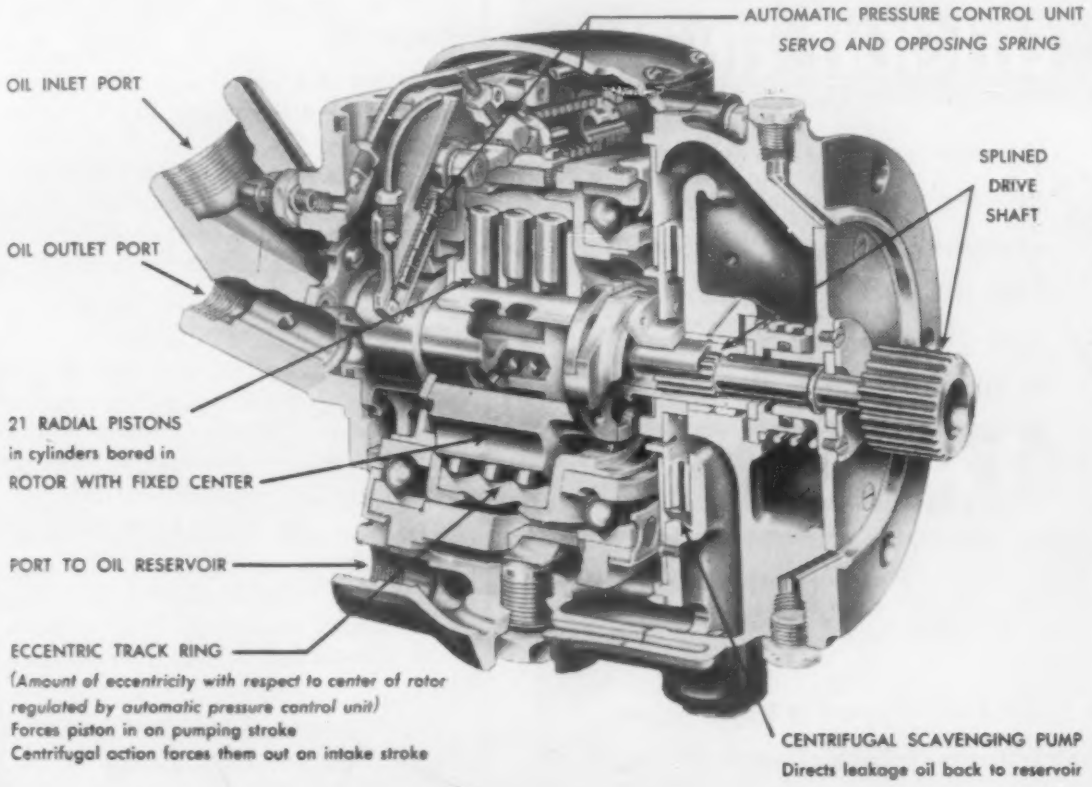
Burton R. Buck has been named works manager of Electro Metallurgical Co., a division of Union Carbide and Carbon Corp.

Ohio Crankshaft Co. has named *Chester H. Kimmel* to the post of vice president and general manager.

General Electric Co. has announced the following appointments: Appliance Control Dept.—*Daniel S. Lisberger,* manager of manufacturing; Medium Induction Motor Dept.—*George I. Clover,* manager of manufacturing; *Charles J. Koch,* manager of engineering; *Dwight E. Moorhead,* manager of the San Jose plant; Synchronous and Specialty Motor and Generator Dept.—*Bascom H. Caldwell,* manager of engineering; *James M. Sullivan,* manager of manufacturing; Transformer Laboratories Dept.—*Horace S. Hubbard,* manager.

Lewis D. Reiff, formerly assistant general manager, Superior Steel & Malleable

Can you help develop a NEW HYDRAULIC PUMP for tomorrow's planes?


AUTOMATIC PRESSURE CONTROL UNIT
SERVO AND OPPOSING SPRING
OIL INLET PORT
OIL OUTLET PORT
SPLINED DRIVE SHAFT
21 RADIAL PISTONS in cylinders bored in ROTOR WITH FIXED CENTER
PORT TO OIL RESERVOIR
ECCENTRIC TRACK RING
(Amount of eccentricity with respect to center of rotor regulated by automatic pressure control unit)
Forces piston in on pumping stroke
Centrifugal action forces them out on intake stroke
CENTRIFUGAL SCAVENGING PUMP
Directs leakage oil back to reservoir

Problem: Modern jet aircraft use hydraulic power not only to actuate landing gear, but also to supplement the pilot's physical strength in moving primary control surfaces when flying at high speeds. Since requirements for this power vary tremendously over widely divergent flight conditions, the pump supplying it must be able to deliver large amounts of oil when needed, and yet operate efficiently with lower power absorption at other times. It also must provide high volumetric efficiency at high speed to avoid cavitation.

Our Answer: A compact, 22-pound unit capable of operating at higher speeds than other commercially developed pumps. The Hamilton Standard variable displacement pump automatically adjusts its flow to meet the requirements of constantly changing flight conditions. It delivers twenty gallons per minute at 6300 rpm yet embodies an automatic stroke control which reduces the oil flow to zero at 3000 psi. Since pistons are filled by centrifugal action, pump is free from cavitation at high speeds.

What's Your Answer? Hamilton Standard's hydraulic pump is operating with high efficiency in today's jet aircraft. But for the future, in order to extend its use to permit operation with fluids of greatly increased temperature, further metallurgical development will be necessary.

This is just one of many challenging engineering projects at Hamilton Standard. In addition to pumps, our growing line of jet aircraft equipment already includes turbine engine starters, fuel controls, cockpit cooling systems, auxiliary drives and other as yet "classified" products. There are also many exciting new developments in world-renowned Hamilton Standard propellers.

Creative Engineering Pays Off at Hamilton Standard

A majority of our company executives are engineers, quick to recognize the value of sound, creative ideas. We have an exceptionally able technical staff now – but we need more experienced metallurgists to meet the demands of the largest research and development program in our 33-year history. If you can help us in this expanding program, there's interesting work and a wonderful opportunity awaiting you at Hamilton Standard.

There's a Future at Hamilton Standard

for Metallurgists

with 3 to 5 years' experience in the field of physical metallurgy. There are openings in both development and quality control, working with a

Wide Variety of Metals and Alloys

including carbon, low alloy, high speed and stainless steels, copper, aluminum, magnesium, silver and titanium alloys—and many others too numerous to mention.

These Positions Offer

- Excellent pay and a fine chance for advancement based on ability.
- A unique opportunity to use your education to the fullest extent on a wide diversity of materials.
- Association with exceptionally high calibre engineering staff – with freedom of decision and responsibility.
- Good housing available in an ideal location with every cultural and recreational advantage – midway between Hartford, Conn., and Springfield, Mass.
- New plant with modern air conditioned offices in a beautiful country setting.
- Secure future with a progressive company whose technical staff has grown steadily for 33 years.

Send resume of your experience to

Engineering Representative
Personnel Dept., Section C

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you owe it to yourself...
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to investigate
IRIDITE®
for on any of these metals Iridite gives you a high performance finish at a low cost from a simple chemical dip.
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you'll find an Iridite that will meet any military or civilian specifications for chromate finishing.
IF PAINT ADHERENCE IS IMPORTANT,
you'll find Iridite prevents underfilm corrosion and soap formation.
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investigate zinc plate and Iridite (Bright) for a chrome-like decorative finish with more corrosion protection than conventional chrome plating . . . or Iridite (Metcote) as a treatment for copper that eliminates the need for buffing in the copper-chrome system; produces a sparkling bright finish!
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for Corrosion Protection and Paint Systems on Non-Ferrous Metals; ARP Plating Brighteners.
West Coast Licensee: L. H. BUTCHER COMPANY

News Digest

Castings Co., has been promoted to vice president in charge of Steel Foundry Operations of the company, and *P. Richmond Schilling,* formerly assistant to the president, has been promoted to vice president in charge of Malleable Foundry Operations.

Robert E. Gentz has been appointed director of management development for Inland Steel Co.'s Indiana Harbor Works. Replacing Mr. Gentz as superintendent of the Sheet and Galvanizing Dept. is *Robert W. Rost,* who has been transferred from the Jersey City plant of the Container Div.

Russel B. Caples, manager of Anaconda's Great Falls, Mont., Reduction Dept., has been elected president and director of Anaconda Aluminum Co. Mr. Caples succeeds *Francis O. Case,* who recently resigned to become president of Glen Alden Coal Co.

Dr. *Elmer H. Schulz* has been promoted to director of research, and Dr. *Maurice J. Day,* to assistant director for program development at Armour Research Foundation, Illinois Institute of Technology.

Alexander Gobus has been named director of North American Philips Co.'s new Non-Destructive Testing Dept.

A reorganization of the Headquarters Manufacturing Div., Westinghouse Electric Corp., has involved shifts in executive responsibility. *C. G. Wallis,* formerly manager of the Headquarters Manufacturing Dept., will now serve as assistant to the vice president. Other appointments include: *L. S. Houk,* as director of works engineering; *N. H. King* and *R. I. Wilson,* director and assistant director, respectively, of production and inventory control; *G. C. Moore,* director of plant industrial engineering; *V. D. Mack,* supervisor of manufacturing student training; and *Joseph Manuele,* director of quality control. Heading up a new department known as the Manufacturing and Equipment Engineering Dept., will be: *W. H. Dickinson,* director of manufacturing engineering, and *G. P. Longabaugh,* equipment engineer. *J. P. Coughlin* has been named manager of the company's Arc Welding Dept.

Carl M. Higbie, Jr, has been appointed president of Higbie Manufacturing Co.

James E. Castle has joined Foote Mineral Co. as manager of the Lithium Mining and Milling Div.

Youngstown Sheet and Tube Co. has announced the following appointments: *Donald W. Lloyd* as general superintendent of the steel plant at Indiana Harbor, East Chicago, Ind., to succeed *George W. Abel,* who died recently; *Thomas Bruce Carpenter* as general superindent at Brier Hill Works to succeed Mr. Lloyd; *James W. Kirkpatrick* as superintendent of the Brier Hill Open Hearth Dept. to succeed Mr. Carpenter; and *Ernest B. Plott* as chief metallurgist in the Youngstown dis-

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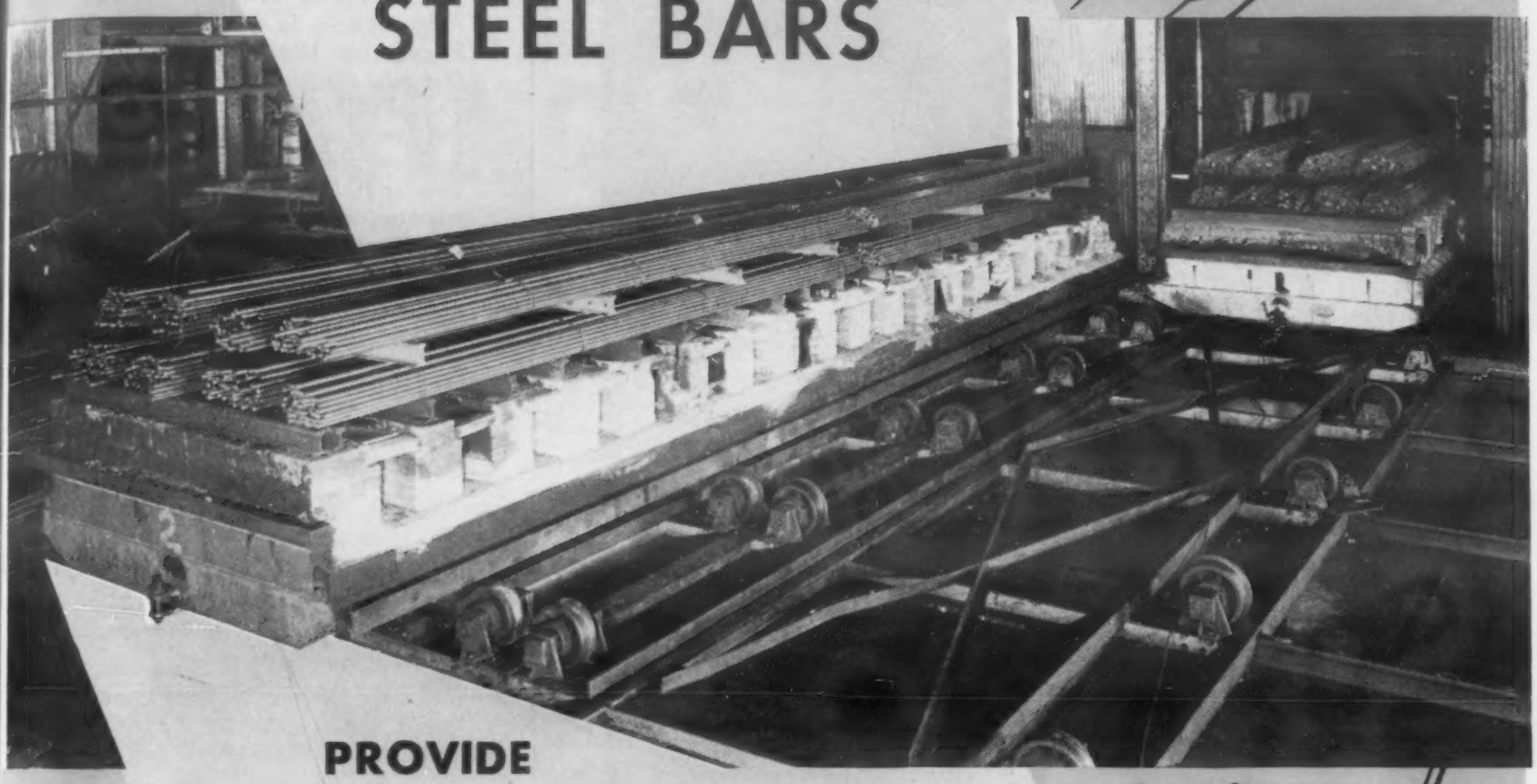
furnace treated
cold finished

STEEL BARS



PROVIDE

- UNIFORMITY THROUGHOUT BARS
- MINIMIZED WARPAGE OR DISTORTION
- ELIMINATION OF CLEANING OPERATION
- GREATLY IMPROVED MACHINABILITY

You can enjoy these and other cost-saving advantages of Wyckoff Furnace Treated Bars by having a Wyckoff metallurgist cooperate with you in selecting the correct grade of steel for your specific requirements. No obligation, of course.

Wyckoff Controlled Quality
CARBON and ALLOY STEELS
TURNED and POLISHED,
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STRAIN and STRESS RELIEVED,
ANNEALED, HEAT TREATED,
QUENCHED and TEMPERED STEELS
WIDE FLATS up to 12" X 2"

SPECIALISTS IN COLD FINISHED STEELS EXCLUSIVELY

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Works: Ambridge, Pa.; Chicago, Ill.; Newark, N.J.; Putnam, Conn.

HERE'S LOW-COST
POSITIVE TEMPERATURE CONTROL
with *Alnor* ACCURACY

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Now—at a cost far less than you may think—you can bring automatic precise temperature control to heat-treating furnaces, bake-ovens, etc.—in fact, to any heating device whether electrically heated or fuel fired. The Alnor Controller is simple in design and operation—you merely set the pointer at the desired cut-off temperature, and it's ready to give you the finest in accurate controller service on new or existing heating equipment. Alnor quality throughout, it features the famous double air gap pyrometer movement; easily read, 6-inch mirrored scale; automatic cold-end compensator; weather-proof, dust-tight case—a truly rugged, precise instrument at a price you can afford. Write today for complete information and price. Illinois Testing Laboratories, Inc., Room 522, 420 N. LaSalle St., Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS
FOR EVERY INDUSTRY

News Digest

trict succeeding Mr. Kirkpatrick.

A. D. Sullivan has been elected vice president in charge of engineering at Brunner Manufacturing Co.

Corning Glass Works has announced the establishment of three new positions and several executive promotions. Appointed to the new post of chief planning engineer in the Manufacturing and Engineering Div., is *Justin J. Pfeiffer,* formerly manufacturing manager of the Technical Products Div. The second of the new posts, chief process engineer in the same division, is being filled by Dr. *Charles F. DeVoe.* Appointed to the new position of assistant general manager in the Electrical Products Div. is *Campbell Rutledge, Jr.* Other appointments include: *Paul T. Clark* to fill Mr. Pfeiffer's post; *Robert E. Ellett* as manager of Pilot Plant No. 2; *Forrest E. Behm, Jr.,* to succeed Mr. Clark as manager of the Pressware Plant; *J. L. Rhodes,* to succeed Mr. Behm as production superintendent at Pressware Plant.

Joseph J. DeWindt and *G. C. Vogel* have been named assistant works manager and general supeintendent, respectively, at Allis-Chalmers Norwood Works.

Elliot Schick has joined the engineering staff, Ebert Electronics Co.

Roy O. Johnson has been named metallurgist and *Charles W. Eastman,* industrial engineer, at Hydraulic Press Mfg. Co.

A. F. Wiest has been placed in charge of all manufacturing operations for Carpenter Steel Co.'s Alloy Tube Div. at Union, N. J.

George W. Howard, chief of the Engineer Research and Development Laboratories, Technical Service Dept., Fort Belvoir, Va., has received the Rockefeller Public Service Award.

Lee C. Becker has been promoted to manager of laboratory operations of Bausch & Lomb Optical Co.'s 155 branches. Mr. Becker succeeds *Roy O. Pennock,* who was recently promoted to vice president and general manager of Bausch & Lomb Optical Co. Ltd. of Canada.

Walter J. Kallmeyer has been named chief engineer of the Standard Steel Corp.

New officers of The U. S. Drill Head Co. are: *A. P. Speckin,* former general manager, president; *J. R. Bashor,* vice president.

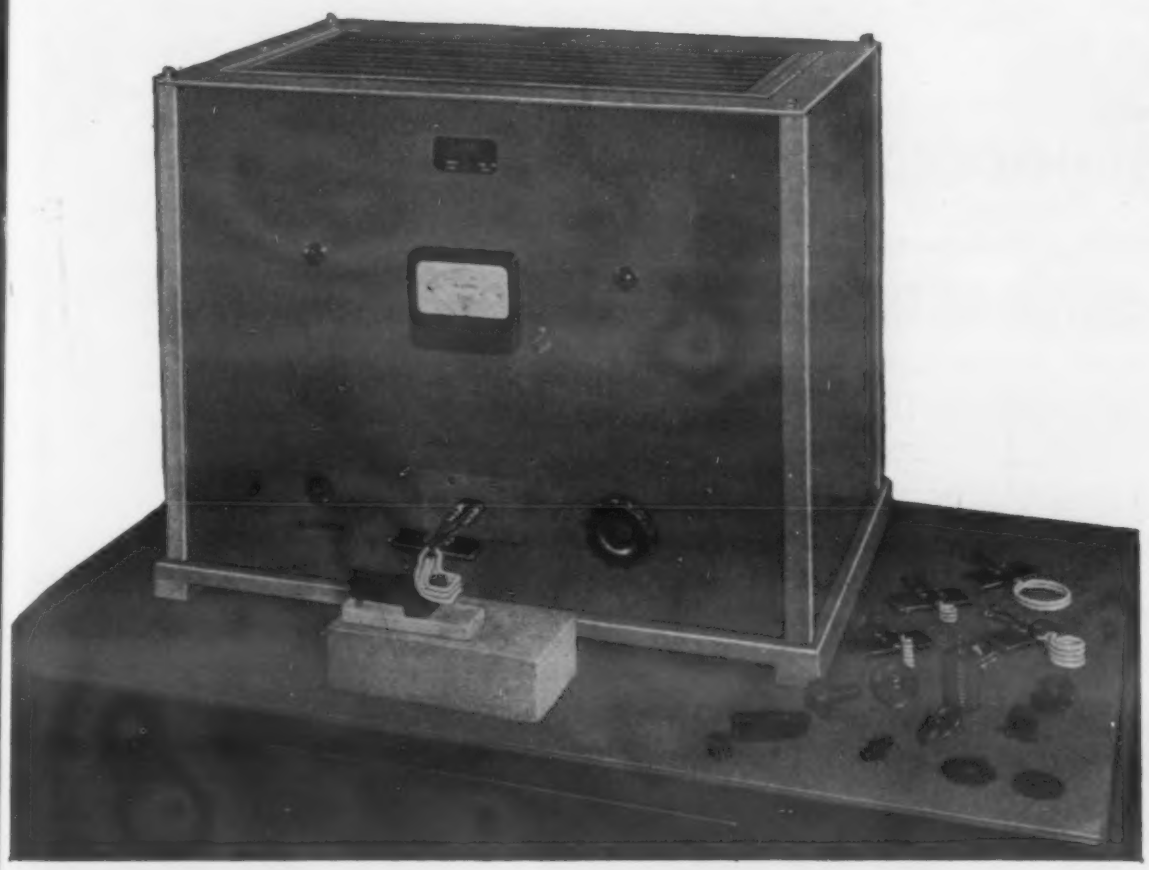
David A. Kuniholm has been named manager of Rodney Hunt Machine Co.'s Special Products Div., in addition to his duties as manager of the Industrial Roll Div.

Leon Podolsky has been appointed to the newly created post of technical assistant to the president at Sprague Electric Co.

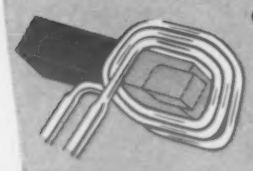
A. B. Fisher, Jr., has been named as-

Lepel presents

A Low Cost PORTABLE HIGH FREQUENCY Induction HEATING UNIT

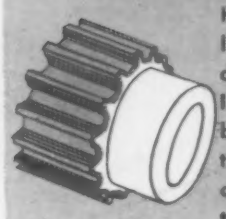


BRAZING



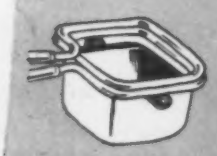
Permits widest choice of silver or copper brazing alloys from lowest to highest melting points. Ideal for brazing carbide tips.

HARDENING



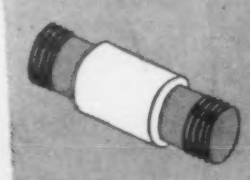
Heat localized exactly where wanted at desired temperature. Ideal for gears, cams, bearing surfaces, cutting tools and other areas that are subject to wear.

SOLDERING



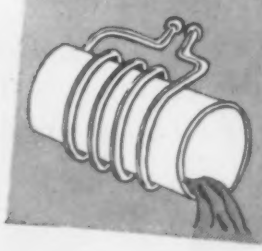
Speedily and neatly performs intricate soldering applications with or without the use of pre-formed rings.

ANNEALING



Ideal for annealing, stress-relieving, normalizing or preheating selected areas.

MELTING



Readily melts quantities of ferrous and non-ferrous metals in either graphite or ceramic crucibles.

- **SMALL AND COMPACT**
  Conveniently operated on bench or table—no mounting necessary.
- **ECONOMICAL OPERATION**
  No special power installation required. Operates on 110 volts, 60 or 50 cycle line at unity power factor.
- **FULLY GUARANTEED**
  Guaranteed for continuous duty cycle and stated performance.

This versatile unit is priced so low that every shop may now take advantage of modern induction heating techniques to improve quality and to increase production. Its simplicity of operation eliminates the need for skilled personnel.

The Lepel Model 2 KW will meet the requirements of machine shops, toolrooms, research laboratories and educational institutions. It is especially suitable for hardening, brazing and soldering small parts of either ferrous or non-ferrous metals.

Complete unit with line connection and load coil.

$870.

f.o.b. factory

WILL HEAT TO 1500° F.

⅛"	steel	rod	1"	length	in	approx.	1 second
¼"	"	"	"	"	"	"	3 seconds
½"	"	"	"	"	"	"	15 seconds
1"	"	"	"	"	"	"	60 seconds

Will melt 4 ounces of brass or steel in 4 minutes.
Equally well suited for heating of non-ferrous metals.

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WRITE FOR LEPEL CATALOG MM-6

HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage** of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field—less than 1%—with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

The accepted melting tool in brass rolling mills throughout the world.

* *Upwards of 5 billion pounds annually.*

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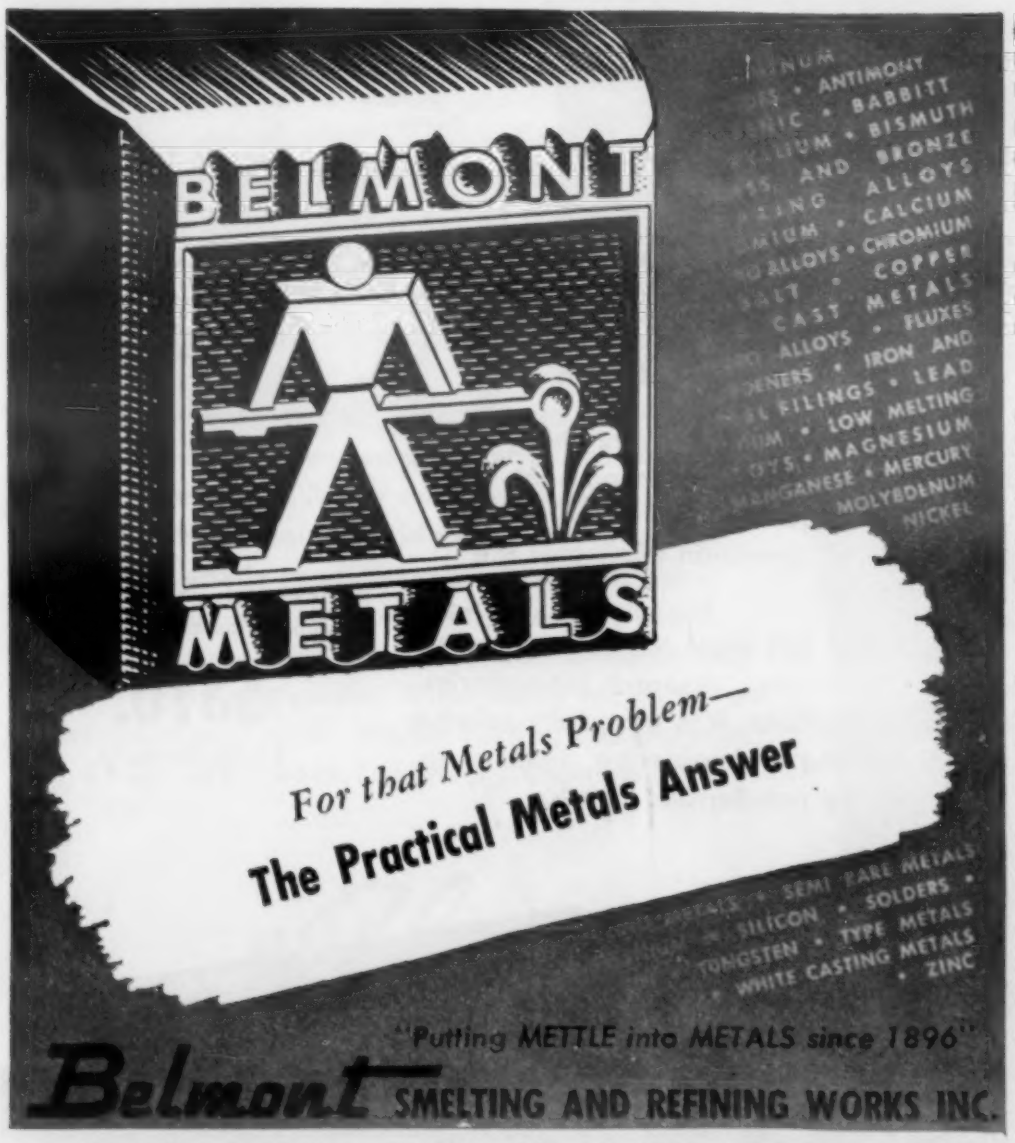
AJAX ELECTRIC COMPANY, INC., *The Ajax-Hultgren Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*



305 Belmont Avenue, Brooklyn 7, N. Y. Dickens 2-4900

News Digest

sistant general manager of the Engineering and Construction Div., Koppers Co., Inc., and *G. P. Wilson, Jr.*, will fill the post of manager of control for the division.

William C. Ridge has been appointed works manager in charge of manufacturing operations of the Trenton and Roebling, N. J., plants of John A. Roebling's Sons Corp.

R. B. Warren has been named manager of Industrial Products Dept., Goodyear Tire & Rubber co.

Henry F. Arndt of the Detroit Electric Furnace Div., Kuhlman Electric Co., has been named chief engineer of the division to replace *Charles V. Kilburn*, who resigned to join the Essex Wire Corp.

Died . . . .

Bertram H. Lawrence, retired vice president-engineering of United States Steel Corp.

George R. Prout, a vice president of General Electric Co.

B. Huntting Howell, president and founder of the Garfield Manufacturing Co.

News of Companies

Ground has been broken for a major expansion program at the *Timken Roller Bearing Co.* plant, Bucyrus, Ohio. Three new single-story structures will be erected at a cost estimated at $1,250,000. Maintenance, repair, electrical and sheet metal departments will be housed in a new toolroom measuring 200 by 100 ft, to which will be attached a 60- by 100-ft office building.

Barber-Colman Co. has announced the opening of a new factory branch office at 537 Harden St., Columbia, S. C.

Auburn Button Works, Inc. has discontinued operation of its *Fibre Glass Molding Dept.* in order to increase production facilities in the Extrusion and Vacuum Forming Div.

Prospects for an important new industry for the Pacific Northwest appear in the offing as a result of confirmation by *Harvey Machine Co., Inc.* that it has purchased the government-built experimental alumina plant in Salem, Ore.

The Plastics Div., Ciba Co., Inc. has established completely new facilities for technical service in a specially designed building at Kimberton, Pa.

Monsanto Chemical Co. is planning to enter the field of manufacturing polyethy-

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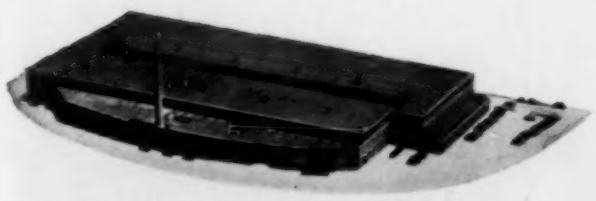

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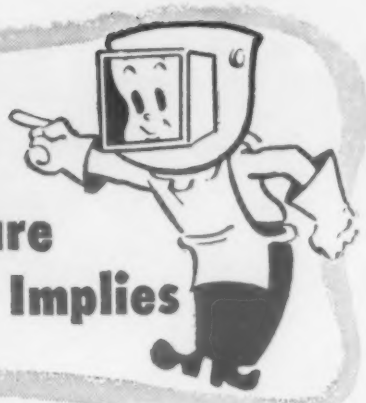

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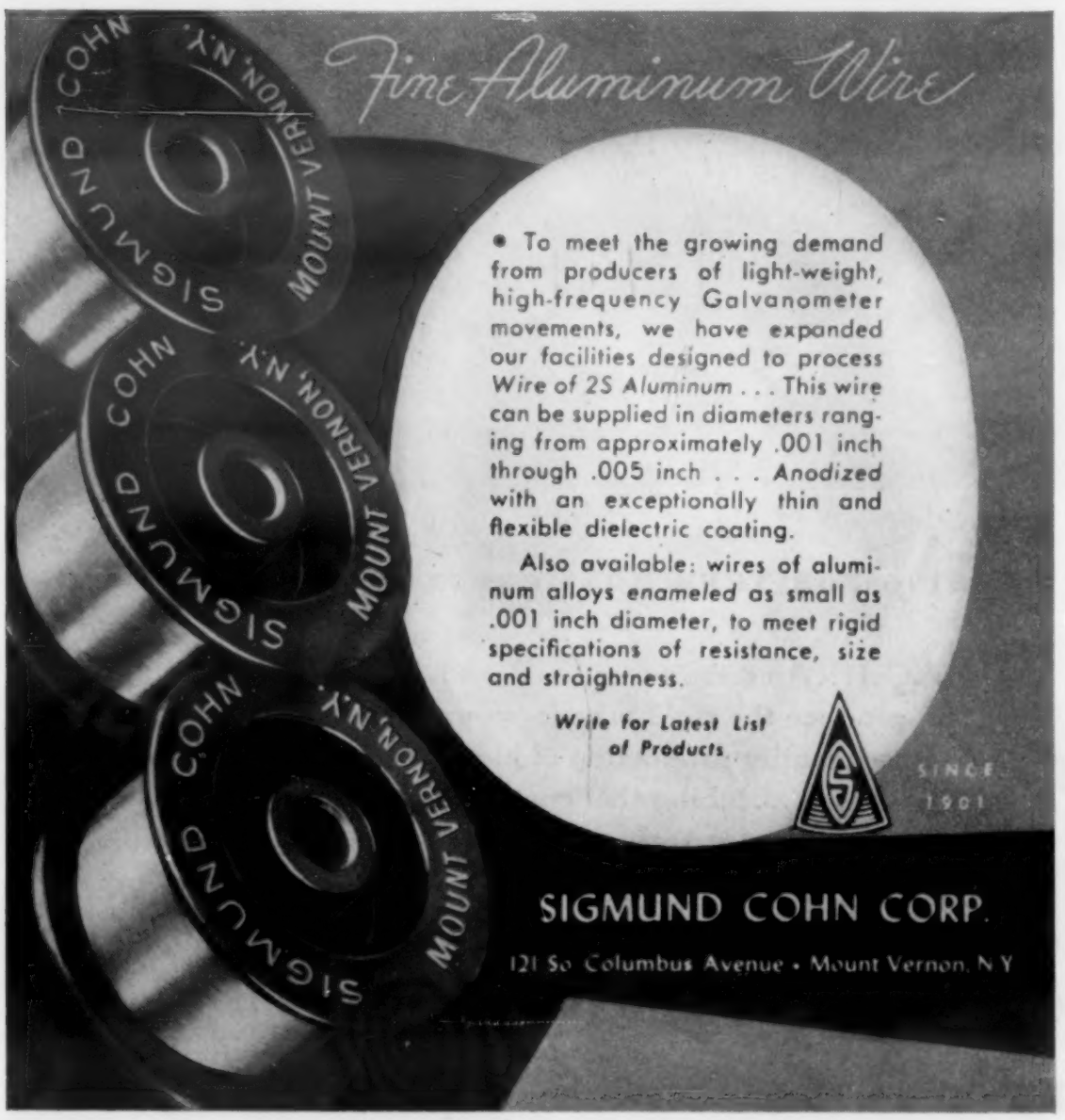
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News Digest

lene plastics, making the company the first to produce the "big six" plastics for molding and fabricating. Initial capacity of the new plant will be about 66 million lb and will be in production early in 1955, with a 50% increase in capacity projected for 1957. This is expected to represent nearly 20% of the total polyethylene capacity in 1957, or 22% of the forecasted market for that year.

A $2 million expansion program, which will include a new 100,000-sq-ft plant now under construction at 1975 N. Ruby St., Melrose Park, has been announced by *Lindberg Steel Treating Co.* The one-story structure, which will double the company's heat treating capacity to more than 50 million lb annually, will house some 200 heat treating furnaces, including more than $1 million worth of new equipment.

Norton Co. took the wraps off the new $6 million expansion of its Grinding Machine Div. when editors recently toured the plant during a preview, which was the opening event in a week-long Open House. The new plant consists of a 740-ft by 300-ft factory joining a 360-ft by 100-ft office building.

Allis-Chalmers Manufacturing Co. has announced a $3 million power modernization and expansion program.

The Dow Chemical Co. will undertake the production of polyethylene. Negotiations for patent licenses and technical knowledge have been made with Imperial Chemical Industries Ltd., a British firm. Dow's Texas Div. at Freeport will construct plant facilities and expects to start production of this plastic in 18 to 24 months.

Raybestos-Manhattan, Inc. has moved from 445 Lake Shore Drive into its newly constructed Chicago office and warehouse building at 6010 Northwest Highway.

Reichhold Chemicals, Inc. has set up a manufacturing division at Ballardvale, Mass., to produce its extensive line of synthetic resins and basic industrial chemicals used by the region's textile paper, plywood, foundry, paint and plastic industries.

H & B American Machine Co. has purchased *Karp Metal Products Co., Inc.*, Brooklyn, N. Y.

Timken Roller Bearing Co. is planning a multi-million dollar expansion program for its Bucyrus, Ohio plant.

The Drawalloy Corp. has expanded its operations and manufacturing facilities with new and enlarged quarters on Lincoln Highway, West at Alloy St., York, Pa.

Bliss & Laughlin, Inc. has announced the early opening of a new cold finished steel bar plant located at Eight Mile Rd. and Hoover Ave., Detroit.

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DUCTALLOY® CASTINGS GIVE KOPPERS FANS

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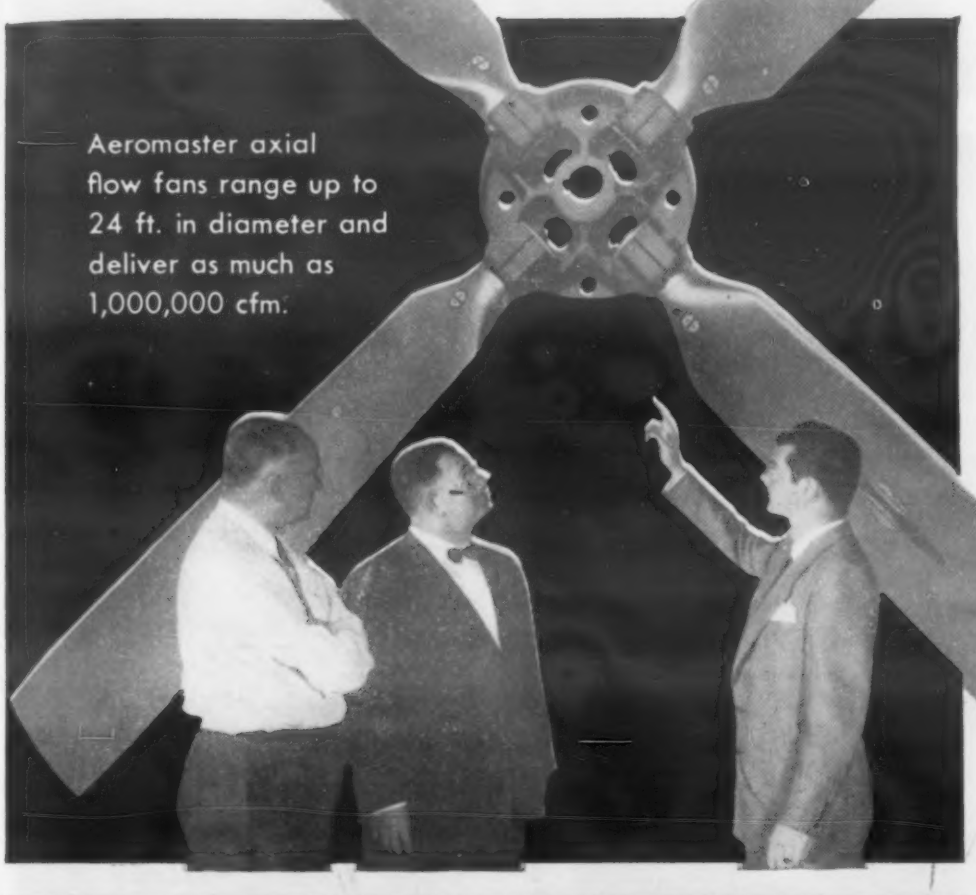

Aeromaster axial flow fans range up to 24 ft. in diameter and deliver as much as 1,000,000 cfm.

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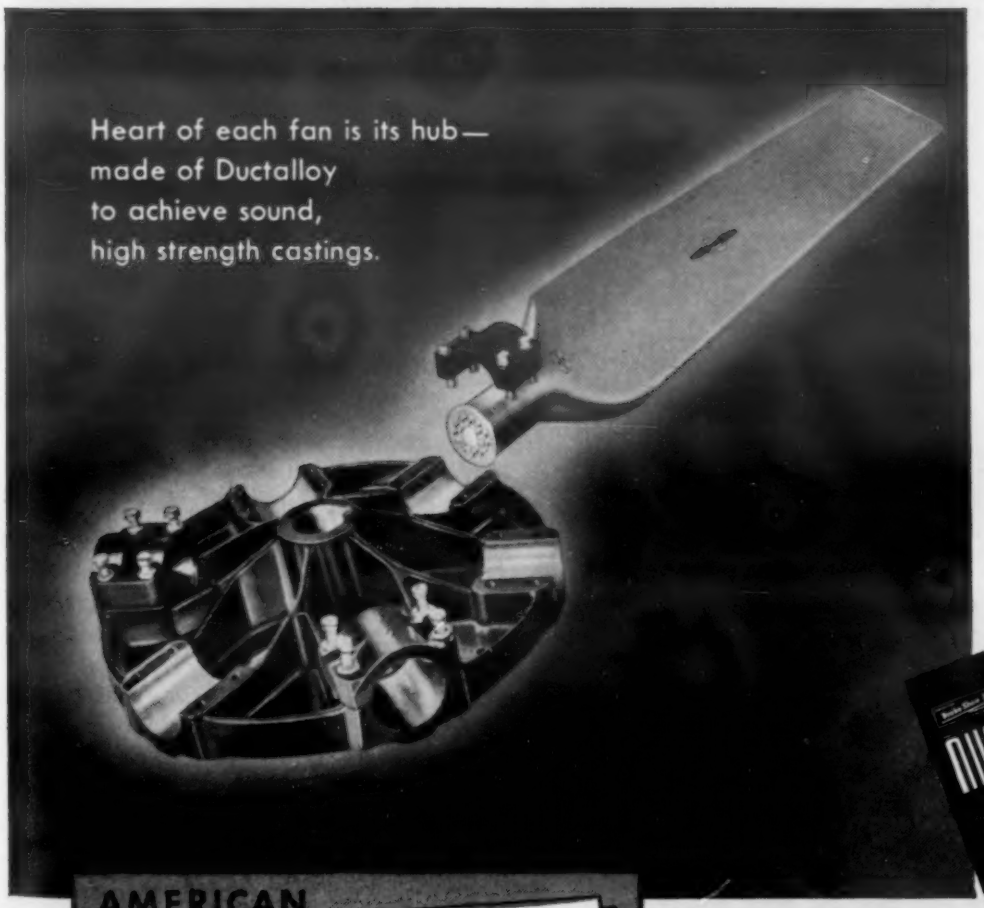
Ductalloy 60 is a ferritic iron having 60,000 psi minimum tensile strength, 40,000 psi minimum yield strength and 10% minimum total elongation, all guaranteed. Use of this material has virtually eliminated the high scrap loss formerly encountered when defects were uncovered during machining of castings made in either steel or malleable iron.



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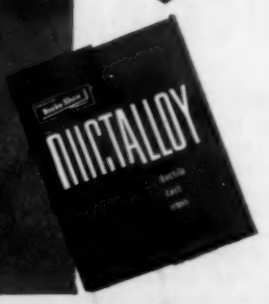

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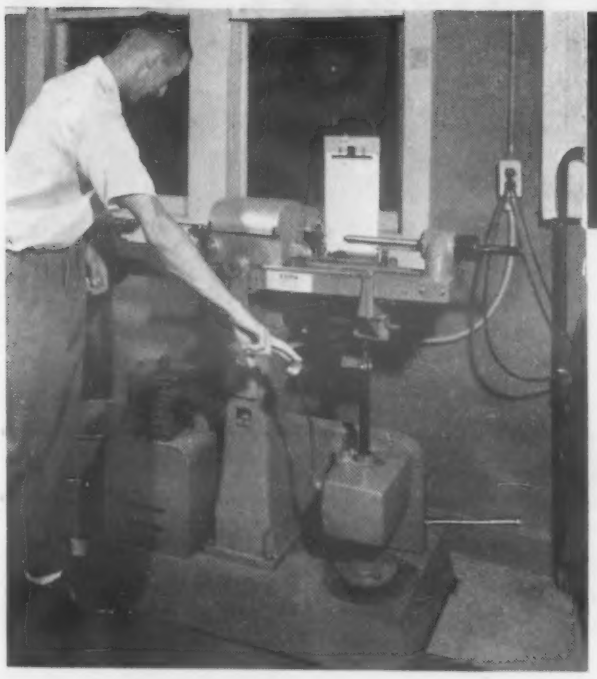

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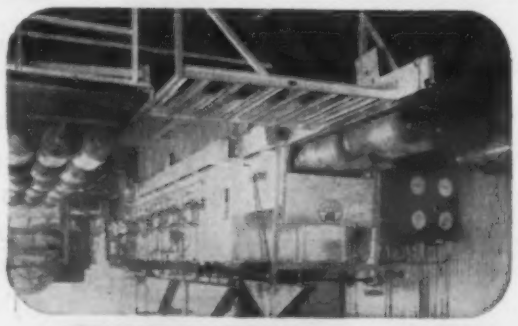

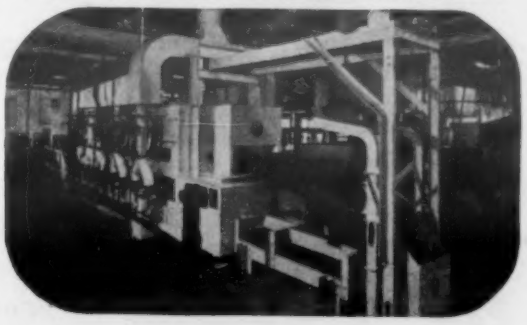

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News Digest

sold by *A. Robinson & Son,* New York, has been taken over by *Technic Inc.,* Providence, R. I.

Joseph Dixon Crucible Co. has announced the formation of a subsidiary corporation, *Dixon Sintaloy, Inc.,* located at 535 Hope St., Stamford, Conn. Recognizing the full scope of recent developments in the control and production of high quality, high strength powdered metallurgy parts, the new company has been equipped with the most modern pressing, die making and laboratory facilities available.

Furane Plastics Inc. is moving to new and larger quarters located a short distance from its present site at 4516 Brazil St., Los Angeles 39.

A $50 million Canadian iron ore project for *Inland Steel Co.* has been announced. *Caland Ore Co., Ltd.,* a Canadian subsidiary of Inland, has leased one of the several iron ore bodies owned by Steep Rock Iron Mines, Ltd., in Steep Rock Lake, Northwestern Ont.

News of Societies

Armour Research Foundation of Illinois Institute of Technology plans to move its expanding administrative headquarters into the five-story Arcade Building at 10 W. 35th St. and the adjoining Binga Bank Building.

For the fourth consecutive year, *Gray Iron Founders' Society, Inc.* is sponsoring its annual Redesign Contest, open to anyone in the metal working industry. The contest offers awards for the best examples of a redesign of a competitive product for production in gray iron.

The nonanalytic factors which enter into engineering and design will be the subject of a special summer program in Product Design from July 6 to 17, 1953 at the *Massachusetts Institute of Technology.*

Dr. Robert B. Sosman, professor at Rutgers University and eminent authority on silica and refractories, received the sixth annual *Albert Victor Bleininger Memorial Award* for distinguished achievement in the field of ceramics.

A $5,000 grant for aid in the study of oxide film, with a view to growing protective films on metals, has been made by Research Corp. to *Stevens Institute of Technology.* The gift is called the Harvey Nathaniel Davis Grant in honor of the late president of Stevens.

Joseph B. Tate, Witt Cornice Co., and Frederick C. Brightly, Jr., Brightly Galvanized Products Co., were presented the

HOW PLASTICS ADD A NEW DIMENSION TO DESIGNING

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This new study of materials trends reviews the steady improvements in plastic raw materials and molding techniques in recent years. It also describes the "property" and performance advantages of plastics (appearance, durability, chemical resistance, etc.) in terms of specific products. And it shows how "one-piece" production . . . with machining, finishing, and assembly operations eliminated or materially reduced . . . can help keep design, engineering, and production in better balance.

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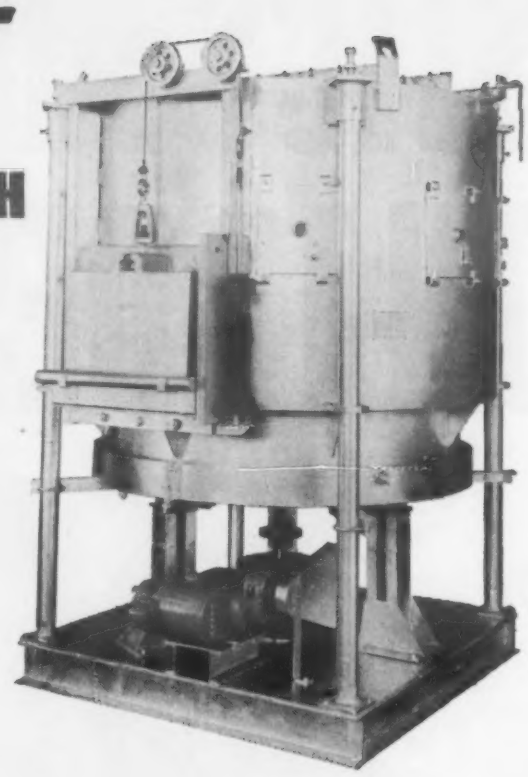

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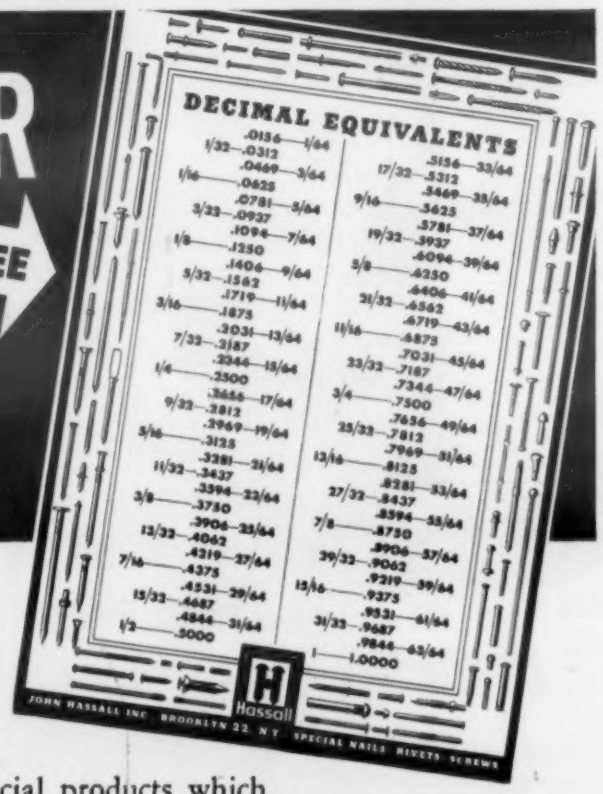

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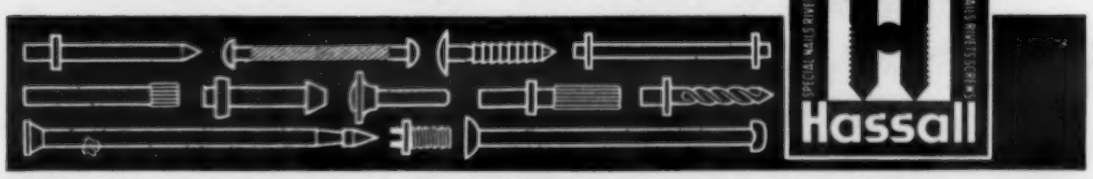

News Digest

Thomas M. Gregory Memorial Award for the years 1951 and 1952 at the *American Hot Dip Galvanizers Assn.* banquet as part of their 1953 annual meeting in Cincinnati.

The annual *Cornell Summer Laboratory Course* in Techniques and Applications of the Electron Microscope will be given this summer from June 15 to June 27, 1953.

Ernest V. Gent, executive vice president, *American Zinc Institute,* was the recipient of the Annual Award of *The Galvanizers Committee* in recognition of his distinguished service to the Committee and the galvanizing industry.

At the opening day's business session of its Twentieth Anniversary convention, the *National Screw Machine Products Association* elected the following officers: A. W. Bonner, M. B. Fetcher Co., president; William N. Grass, M. J. Grass Screw Machine Products, vice president; and Charles D. Hoyt, Jr., Charles D. Hoyt Co., Inc., treasurer.

At the Aeronautic Meeting dinner held in April, *The Society of Automotive Engineers, Inc.* presented its *Wright Brothers Medal* to W. J. Kunz, Jr. of Bendix Aviation Corp. The award went to Mr. Kunz for his paper, "A New Technique for Investigating Jet Engine Compressor Stall and Other Transient Characteristics", which he presented at the SAE Spring Aeronautic Meeting in New York a year ago.

Dr. Frederick D. Rossini, Silliman Professor and Head of the Dept. of Chemistry and Director of the American Petroleum Institute Research Lab. at the Carnegie Institute of Technology, will present the 27th *Edgar Marburg Lecture* on the subject "An Excursion in Petroleum Chemistry." The lecture will be given at the annual meeting of the *American Society for Testing Materials,* held in Atlantic City, June 29 through July 3. Jerome Strauss, vice president, Vanadium Corp. of America, will present the second *H. W. Gillett Memorial Lecture* on Micrometallurgy at the meeting.

William O. Hildreth was one of eight engineers in the United States to receive a citation for 65 years' membership in the *American Society of Mechanical Engineers.* Until his retirement a few years ago, Mr. Hildreth was active in the Syracuse Plant, Lamson Corp.

J. B. Haffner, vice president and general manager, The Bunker Hill & Sullivan Mining & Concentrating Co., was elected president, *The Lead Industries Association,* at its 25th annual meeting held at the Greenbrier Hotel, White Sulphur Springs. Mr. Haffner succeeds Felix Edgar Wormser, vice president, St. Joseph Lead Co., who has been nominated by President Eisenhower to become assistant secretary of the Interior for Mineral Resources.

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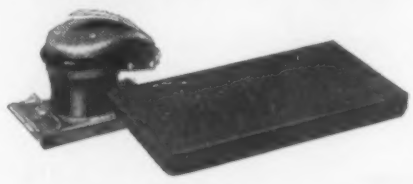
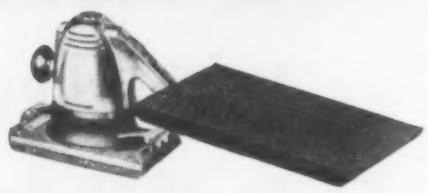
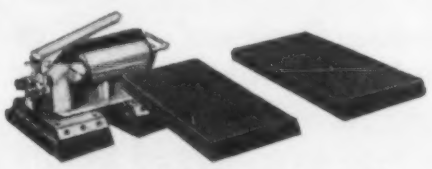


National Model 100—equipped with Natural Sponge Rubber Pad by Roth.

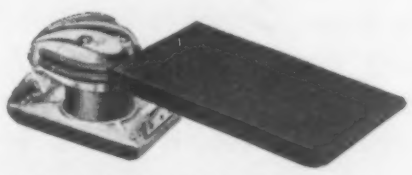


National Model 500—equipped with non-conducting Neoprene Sponge Rubber Pad by Roth.



National Model 300A—equipped with two Neoprene Sponge Rubber Pads by Roth.

National Model 600—equipped with Natural Sponge Rubber Pad by Roth.



National Model 400—equipped with oil-resistant Neoprene Sponge Rubber Pad by Roth.

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Briefs

ENAMEL STICKS Laboratory tests show that satisfactory adherence of enamel to low-carbon steel or enameling iron can be achieved without expensive preparation or use of scarce nickel and cobalt.

MORE COLOR Galvanized sheet steel in many colors is the object of a research project now underway.

NODULAR IRON For nodular iron, a high elongation value in the tensile test does not necessarily mean the material will behave in a ductile manner in the impact test, recent British findings show.

MAGNETIC CLUTCHES Powdered iron particles in magnetic clutches had to be replaced by powdered stainless steel particles to resist humidity and heat.

STEEL ANALYSIS A newly developed unit employing radio frequency inductive heating makes it possible to determine both iron and sulfur in ferrous alloys in a single operation requiring only 10 min.

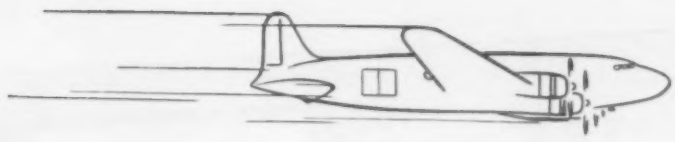
ALUMINUM WIRE Several manufacturers of aluminum electrical wire and cable are now using an Italian continuous casting and rolling process to make "redraw rod" for wire drawing. It is said to save money, particularly for small producers.

CONSERVING BORT Five ways to save diamond bort in grinding have been found: silicon carbide paper belt grinding, ultrasonic, electrosparking, electroarcing and electrolytic, the latter having several variations.

GASKETS Bolted steel storage tanks used by Army Engineers are now effectively sealed from leakage with new extra soft Hycar rubber gaskets developed by Thermoid Corp. in cooperation with E.R.D.L.

PORCELAIN ENAMEL Now under study is the development of a standard test method for determining the alkali resistance of porcelain enamel. A major purpose is to aid the formulation of porcelain enamels to meet conditions resulting from alkaline detergents of widely varying composition used in appliances.

MORE PLASTICS Sales of plastics products in Canada and the United States will triple in volume by 1960, with the greatest advance being in structural applications, according to one expert.



Diaphragm-type valve assures dependability in aircraft fuel systems!

Rugged Du Pont "Fairprene" meets rigid specifications

"TEFLON"*
Tetrafluoroethylene resin coated glass fabrics

These materials, designed primarily for the electrical industries, have found many applications in other fields because of their unique combination of properties. Diaphragms, gaskets, conveyor belts, fuel cells, and nonsticking covers for heating elements on packaging equipment are only a few of the other uses to which they have been put.

Their extraordinary properties include:

Flexibility at -100°F., continuous use at 1500°F., essentially complete chemical resistance, self lubrication, and exceptional anti-adhesive or non-sticking ability.

For further information on the properties and uses of these unique materials clip and mail the coupon below.

*REG. U.S. PAT. OFF.

The Parker level control and pilot shutoff valves, used to regulate fuel transfer within an airplane and for high-speed refueling, are of diaphragm-type construction. This type valve is not affected by contaminant or foreign matter in the fuel, which could cause other types to stick.

However, extremely durable diaphragm material is needed for diaphragm-type valves. The material, as incorporated in the Parker valves, consists of two thin diaphragms used together which must provide a burst strength of over 800 psi. It must operate satisfactorily over a temperature range from –65°F. to as high as +250°F. And it must resist all types of aviation fuel, including those with aromatic content up to 30%.

The Parker Appliance Company, to do this job, chose Du Pont "Fairprene"† No. 5029-A coated nylon fabric. Not only did the "Fairprene" fulfill every requirement as a diaphragm, but it also serves as a gasket material.

"Fairprene" is preferred in many kinds of diaphragms—and in hundreds of other industrial uses—because it's tough, flexible and lightweight. "Fairprene" has a low permanent set or drift and resists aging in air or oxygen as well as gasoline, grease and kerosene.

Du Pont engineers will gladly work with you to evaluate "Fairprene" for designing new products, or for improving your present products or manufacturing methods. They'll work with you in engineering special grades of "Fairprene" to meet *your specific needs*. For prompt assistance, fill out and mail the coupon below.

DU PONT "FAIRPRENE"

synthetic elastic compositions

"ENGINEERED TO DO YOUR JOB BETTER"

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BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

†**"FAIRPRENE"** *is Du Pont's registered trade mark for its line of products made from synthetic elastomers available in the form of coated fabrics, sheet stocks without fabric insert and adhesives.*

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Empire State Building, New York 1, N. Y.

☐ Please send me booklet "'FAIRPRENE' synthetic elastic compositions."
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Chrome-Nickel Alloy Powder — 800 A Sup

Supplemental data on **Custom Alloy Powders** for **Alloy Steel Compositions*** ...high tensile strength

*50% Chromium—50% Nickel Alloy powder combined with 1% Graphite and electrolytic iron powder.

Tensile strength psi 121,000

(Sintered 2 hrs. at 1200°C.)

Sintered density	6.97
Elongation % in 1"	2.5
Rockwell Hardness	B-99

Multiple advantages accrue to you through the use of MH Chrome Nickel alloy powders for Alloy Steel compositions in your powder metallurgy molding —

- volume production of intricate parts, having higher tensile strength
- miniaturization of parts with greater strength and less mass
- no scrap or waste, no milling or finishing required

Fine particle size is an outstanding feature of MH Chrome Nickel alloy powders, as indicated on the chart below.

COMPARISON OF EFFECTS OF HEAT TREATMENT ON PROPERTIES OF ELECTROLYTIC IRON POWDER PLUS ALLOYS OF VARIED NICKEL—CHROMIUM CONTENTS

Compacting Pressure — 50 tsi
Sintering Condition — 1100°C for 1 hour at temperature in hydrogen

MATERIAL	Electrolytic Iron + 1% Graphite + 10% Alloy (80% Ni — 20% Cr) TENSILE STRENGTH PSI	ELONGATION %IN 1"	ROCKWELL HARDNESS	SINTERED DENSITY G/CC	Electrolytic Iron + 1% Graphite + 10% Alloy (80% Cr — 20% Ni) TENSILE STRENGTH PSI	ELONGATION %IN 1"	ROCKWELL HARDNESS	SINTERED DENSITY G/CC
Sintered	72200	2.5	R_B83	7.11	66100	2.0	R_B99	6.64
Coined	76300	4.6	R_B85	7.18	63000	2.0	R_B95	6.65
Coined & Annealed	71000	3.5	R_B84	7.15	83000	2.0	R_B95	6.65
Coined & Quenched	76900	1.7	R_C25	7.08	84400	2.0	R_B100	6.65
Coined, Quenched & Annealed	99500	0.5	R_C15	7.08	92900	2.0	R_B96	6.65
Quenched	75800	2.3	R_C19	7.11	84000	2.0	R_B97	6.65
Quenched & Annealed	88650	2.3	R_C16	7.11	77300	2.0	R_B95	6.65

SIZE CHARACTERISTICS

(80% Ni — 20% Cr)		(80% Cr — 20% Ni)		(50% Cr — 50% Ni)	
+100	2.4%	−100 +200	4.7	+100 mesh	0.8%
−100 +200	31.9%	−200 +325	9.7	−100 +150	4.5
−200 +325	28.5%	−325	85.6	−150 +200	8.9
−325	37.2%			−200 +270	11.0
				−270 +325	12.2
				−325	62.6
				Apparent Density g/cc By Scott Volumeter	1.89

For detailed information, write:

METAL HYDRIDES INC

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Technical Reports on Materials

COMPRESSION TESTS ON DURAL-CELLUBOARD SANDWICH PANELS. *K. H. V. Britten, Aeronautical Research Council, Great Britain (1952). Report N-21593, 18 pp.* Available on loan from National Advisory Committee for Aeronautics, 1724 F St., Washington 25, D. C. Results of compression tests on 56 panels with birch spruce or whitewood centers.

SYMPOSIA ON MATERIALS AND DESIGN FOR LIGHTWEIGHT CONSTRUCTION, THE TITANIUM SEMINAR. *Report PB 111083, 95 pp.* Available from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Mimeo $2.50. Eight papers describing technical advances in titanium originally presented at a symposium held in May 1951 by the Army's Engineer Research and Development Laboratories. Included are: History of Titanium; Present Production Status of Titanium; Production Properties and Uses of High Purity Titanium; Physical and Mechanical Properties of Commercial Titanium and Its Alloys; Corrosion Resistance of Titanium and Its Alloys; Shop Characteristics of Commercial Titanium and Its Alloys; Casting and Forging of Titanium and Its Alloys; and Applications and Potential Uses for Titanium and Its Alloys.

THE PLASTIC DEFORMATION OF SINGLE CRYSTALS OF ALUMINUM. *R. D. Johnson, A. P. Young, W. B. Wilson and A. D. Schwope, Battelle Memorial Institute (1952). Report N-19882, 59 pp. Available on loan from National Advisory Committee for Aeronautics, 1724 F St., Washington 25, D. C.* Creep studies in temperature range 700 to 1100 F. Effects of small amounts of prestraining.

DIRECT-READING DESIGN CHARTS FOR 24S-T3 ALUMINUM ALLOY FLAT COMPRESSION PANELS HAVING LONGITUDINAL FORMED HAT-SECTION STIFFENERS AND COMPARISONS WITH PANELS HAVING Z-SECTION STIFFENERS. *William A. Hickman and Norris F. Dow, Langley Aeronautical Laboratory (1953). NACA TN 2792, 71 pp. Available from National Advisory Committee for Aeronautics, 1724 F St., Washington 25, D. C.*

Half mile of HELIARC TRADE MARK welds OK'D by rigid X-ray tests

A midwest manufacturer was faced with the problem of getting X-ray quality welds in aluminum vessels. These welds were subject to pressure and had to be entirely free from porosity and oxide inclusions. After thoroughly investigating customer specifications, LINDE's service engineers recommended HELIARC inert gas shielded welding for the job.

Since then, about a half mile of these HELIARC welds have been OK'd by 100% X-ray inspections. According to company officials, HELIARC welding was "perfect for the job" and meant real savings by getting X-ray quality welds the first time without expensive rejections or repairs.

Whether you weld aluminum or other hard-to-weld metals, you, too, will find that fast, clean, HELIARC welding will save you time and production costs. HELIARC welding takes place under a shield of inert argon gas which eliminates the need for flux. As a result, HELIARC welds are free from porosity and oxide inclusions. This means fewer rejects and lower finishing costs. In fact, spatter-free HELIARC welds in many cases can be left "as welded."

You owe it to yourself and to your Company to find out more about the cost saving benefits of HELIARC welding. Call your local LINDE representative today. He will be glad to furnish you with detailed information on HELIARC welding.

LEFT Welding heavy aluminum sections with HELIARC *HW-10 torch. These welds were strong, dense, and required little finishing. BELOW The 300 amp.* HELIARC *torch has all-internal water-cooling of both torch head and power cable for cool, long-lasting operation. The HW-10 also features quick electrode adjustment.*

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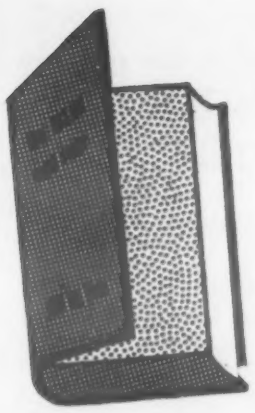

BOOK REVIEWS

RADIOISOTOPES IN INDUSTRY. *Edited by John R. Bradford. Published by Reinhold Publishing Corp., New York 36, N. Y., 1953. Cloth, 6 by 9 in., 309 pp. Price $8.00.* Based on a series of lectures presented at Case Institute of Technology, this book covers all of the important industrial uses of radioactive isotopes. The original material was since amended to include the most recent developments in the field. Amply illustrated with halftones, tables and graphs, the book covers not only the many uses of radioisotopes, but also such important related topics as laboratory construction, shielding, personnel protection, handling techniques, and radioactive waste disposal.

ENGINEERING MANUFACTURING METHODS. *By Gilbert S. Schaller. Published by McGraw-Hill Book Co., New York 36, N. Y., 1953. Cloth, 6 by 9 in., 613 pp. Price $7.00.* Here is an authoritative and fundamental text for a standard course in the manufacturing processes required of the mechanical engineering student. The author attempts to integrate manufacturing methods into the engineering educational program through use and correlation of engineering design, material and production standards and codes in discussion. The presentation is based on fundamentals and offers a comprehensive survey of the field. All major aspects of engineering manufacture are presented—founding, machining, welding, hot and cold shaping, thermal treatment, and engineering materials, as well as a special emphasis on the latest technological developments. In addition to the usual iron and steel materials, the text covers light metals, plastics and copper-base alloys.

ASTM SPECIFICATIONS FOR STEEL PIPING MATERIALS. *Prepared by ASTM Committee A-1 on Steel. Published by American Society for Testing Materials, Philadelphia 3, Pa., 1952. Paper, 6 by 9 in., 394 pp. Price $3.75.* The Dec. 1952 edition of this compilation contains in the latest approved form the 56 widely used ASTM specifications for carbon-steel and alloy-steel pipe and tubing, including stainless. New specifications include: quenched and tempered alloy steel bolts and studs with suitable nuts; electric-fusion-welded austenitic chromium-nickel alloy steel pipe for high temperature service; iron-chromium and iron-chromium-nickel alloy tubular centrifugal castings for general applications. Sixteen Emergency Alternate Provisions applying to specifications in this compilation are printed in the pink section at the back of the book. (These are issued by the ASTM in accordance with a special procedure in the interest of expediting procurement or conservation of materials during the period of National Emergency.)

EQUIPMENT FOR THE THERMAL TREATMENT OF NON-FERROUS METALS AND ALLOYS. *Institute of Metals Monograph and Report Series No. 14. Published by the Institute of Metals, London, England, 1953. Cloth, 9 by 11 in., 104 pp. Price $2.50.* Here is a compilation of the papers presented at the annual general meeting of the Institute, Mar. 26, 1952. Included are: "Electric Furnaces for the Thermal Treatment of Non-Ferrous Metals and Alloys"; "Gas Equipment for the Thermal Treatment of Non-Ferrous Metals and Alloys"; "Batch and Continuous Annealing of Copper and Copper Alloys"; "Bright Annealing of Nickel and Its Alloys"; "Bath Thermal Treatment of Light Alloys"; "Flash Annealing of Light Alloys"; "Continuous Heat-Treatment of Aluminum Alloys of the Duralumin Type".

MECHANICAL INSPECTION. *By W. H. Armstrong. Published by McGraw-Hill Book Co., New York 36, N. Y., 1953. Cloth, 6 by 9 in., 361 pp. Price $5.50.* A practical manual with great simplicity in presentation, this book is designed to train inexperienced men and women as inspectors in machine shops or other related industries. Primarily for use in class work of technical institutes, vocational industrial schools, or industrial training programs, the volume is also sufficiently clear and detailed for self-instruction. Major emphasis here is on descriptions of tools which are used for dimensional inspection of machine shop products, and explanations of methods used by inspectors. Also included are treatments of hardness testing, magnaflux and radiographic inspection, and statistical quality control. All topics necessary to the inspector—blueprint reading, shop mathematics of inspection, inspection discussions (including the relationship between mechanical inspection and statistical quality control), and surveys of non-precision and measuring tools used by inspectors—are offered in this volume.

SIMPLIFIED DRAFTING PRACTICE. *By William L. Healy and Arthur H. Rau. Published by John Wiley & Sons, Inc., New York 16, N. Y., 1953. Cloth, 9 by 11 in., 156 pp. Price $5.00.* This book marks the first major change in industrial drafting practice in many years, teaching new methods that are vitally necessary if the draftsman is to keep in step with the trend of modern industrial progress. Here are some of the principles the authors express designed to guide the draftsman in his work: Simplification of delineation; elimination of non-essentials; and extensive use of freehand drawing. Tests have proved that freehand drawing, when used sensibly, is both practical and economical. Other factors being equal, this technique alone can reduce the average draftsman's drawing time 20 to 30%. Illustrations are abundant here and are specifically designed to show the reader how to operate the direct and simple way.

1952 BOOK OF ASTM STANDARDS. *Published by the American Society for Testing Materials, Philadelphia 3, Pa., 1953. 9975 pp.—in Seven Parts. Price, $76.00 for complete set; Parts 1, 3, 6—$12.00 each; Parts 2, 4, 5, 7—$10.00 each.* With over 9975 pages, including the more than 2001 standards, specifications, tests and definitions for materials, the 1952 Book of ASTM Standards is issued in seven parts:

Part 1—Ferrous Metals; 291 Standards; 1602 pp.
Part 2—Nonferrous Metals; 268 Standards; 1359 pp.
Part 3—Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing and Soils; 405 Standards; 1666 pp.
Part 4—Paint, Naval Stores, Wood, Fire Tests, Sandwich Constructions, Building Constructions; 273 Standards; 1182 pp.
Part 5—Fuels, Petroleum, Aromatic Hydrocarbons and Engine Antifreezes; 213 Standards; 1282 pp.
Part 6—Rubber, Plastics and Electrical Insulation; 257 Standards; 1520 pp.
Part 7—Textiles, Soap, Water, Paper, Adhesives and Shipping Containers; 294 Standards; 1364 pp.

Each part of the 1952 Book is complete with detailed subject index and two tables of contents. To keep the books up-to-date, a supplement will be issued to each part in 1953. As a service with the 1952 edition, there is a complete index to standards furnished without additional charge.

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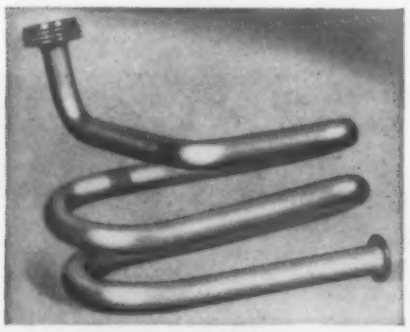

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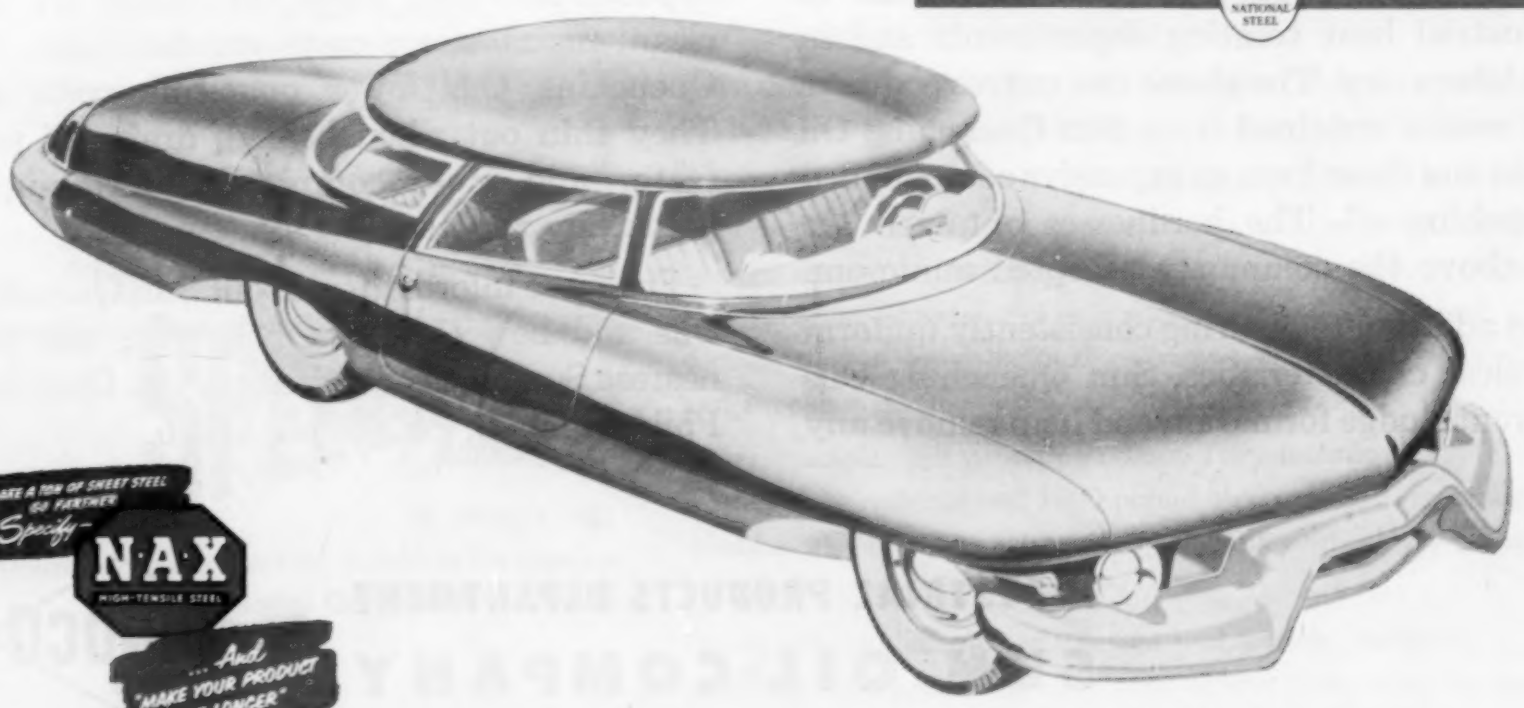

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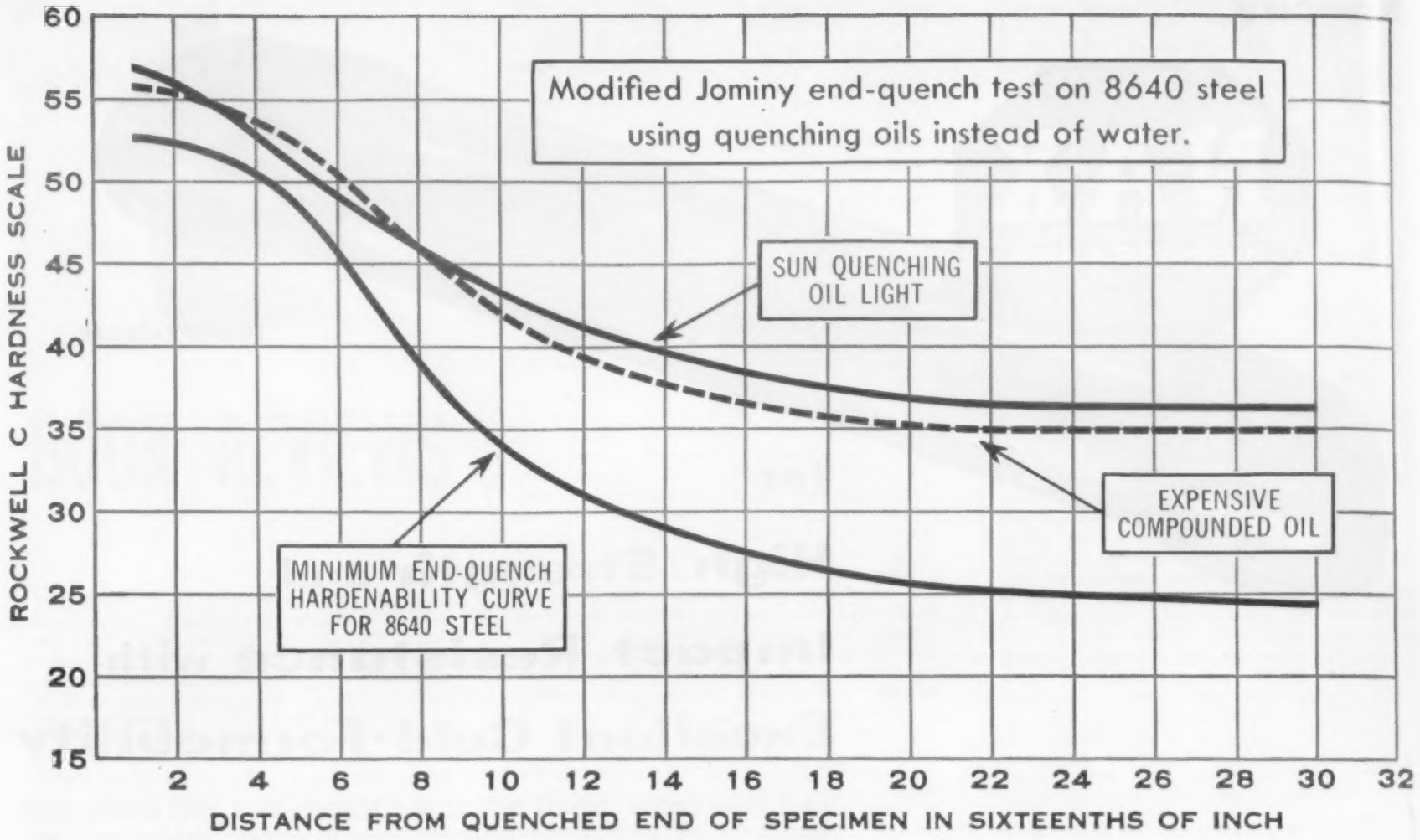

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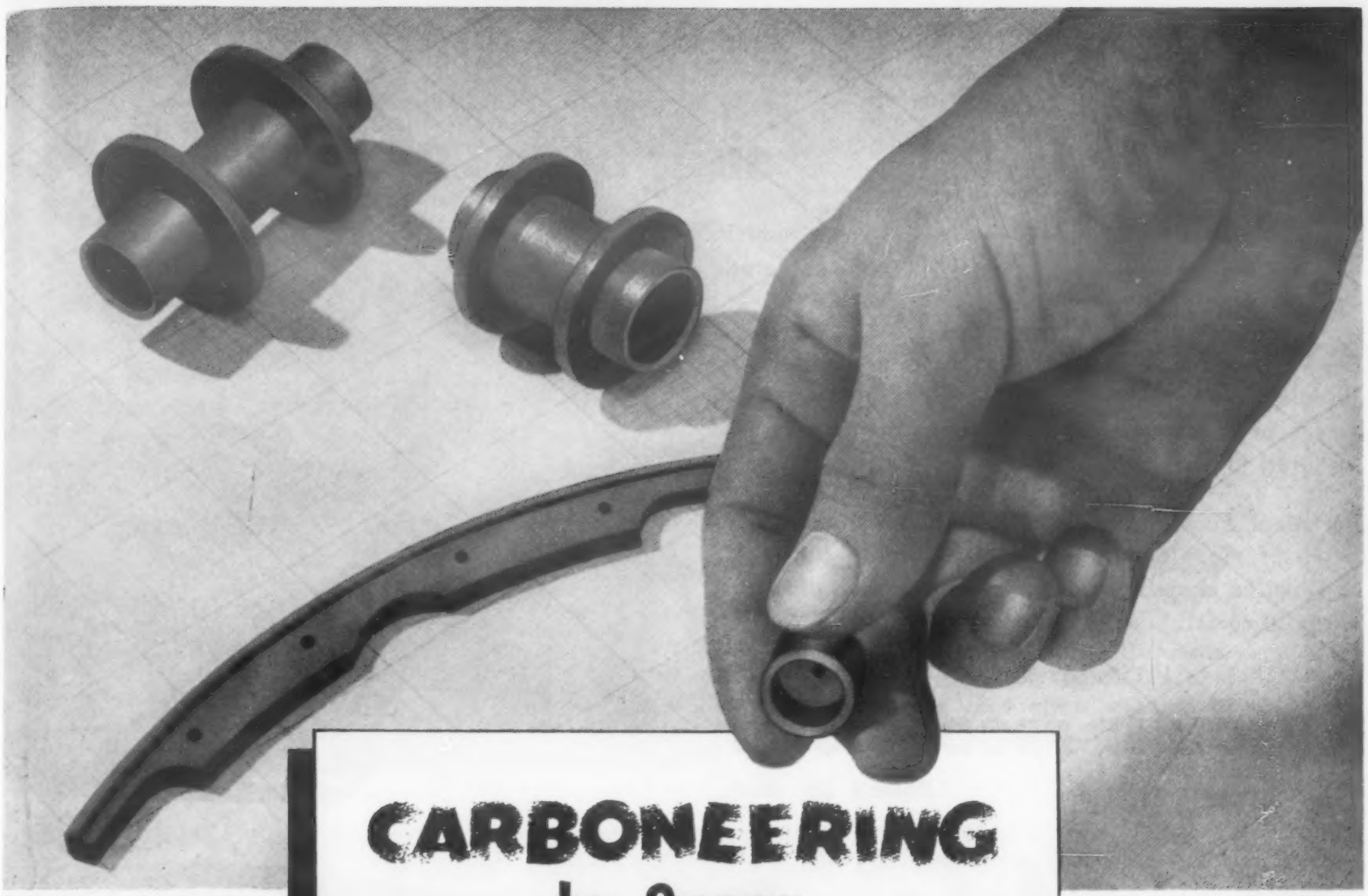

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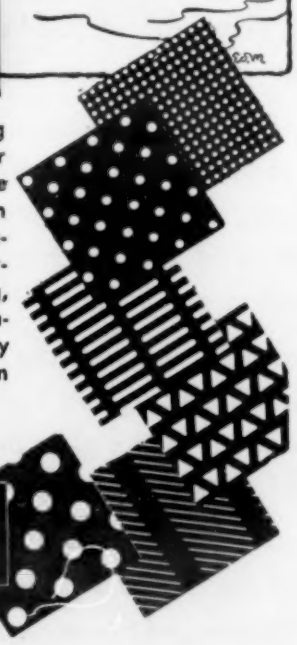

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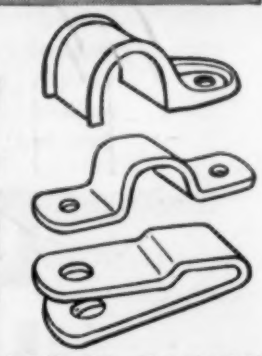

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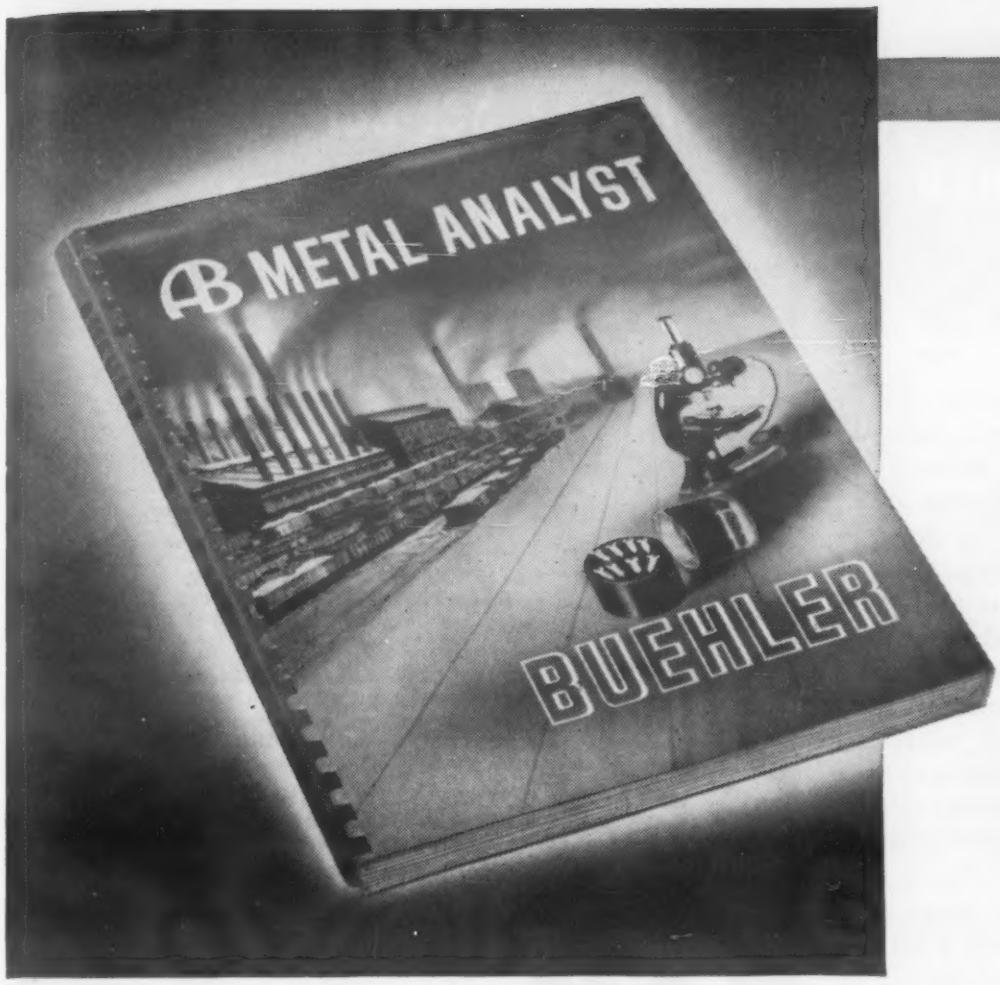

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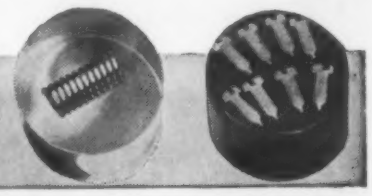

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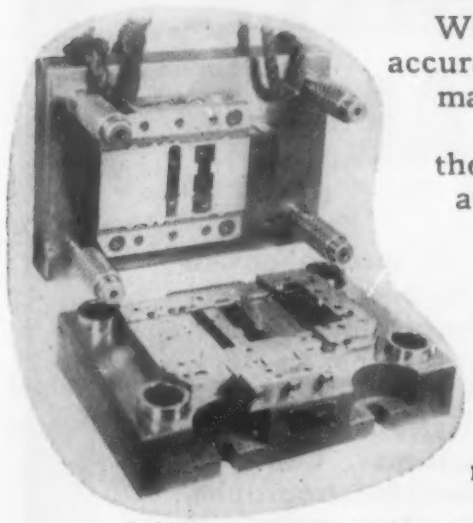

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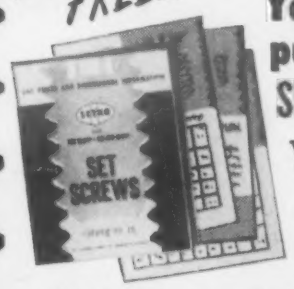

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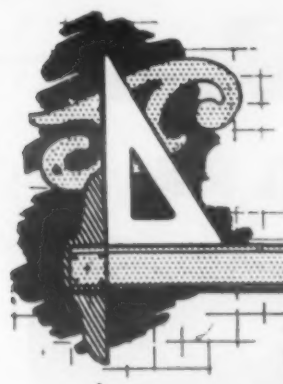

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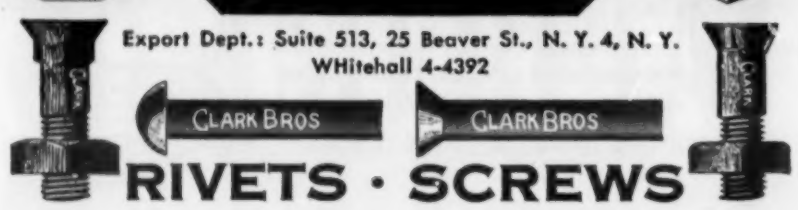

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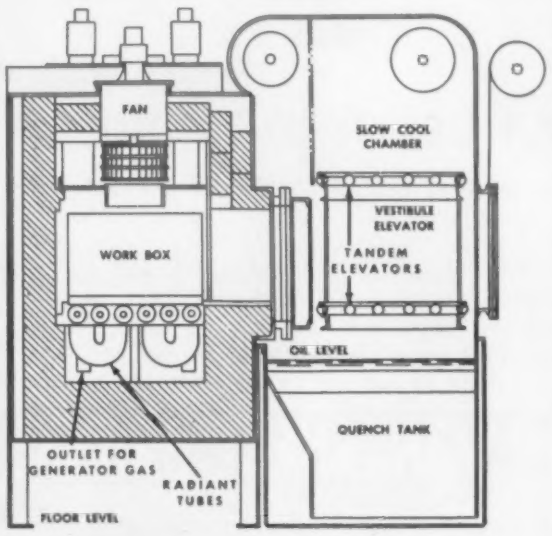

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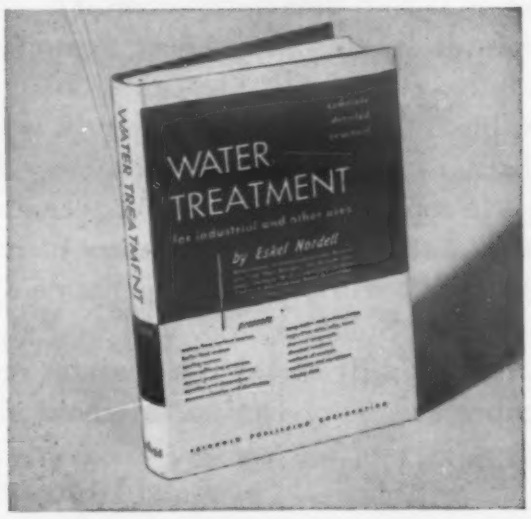

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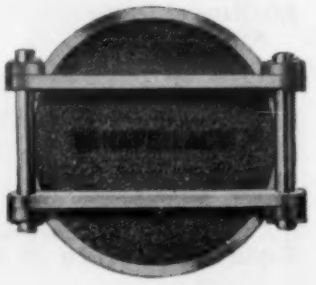

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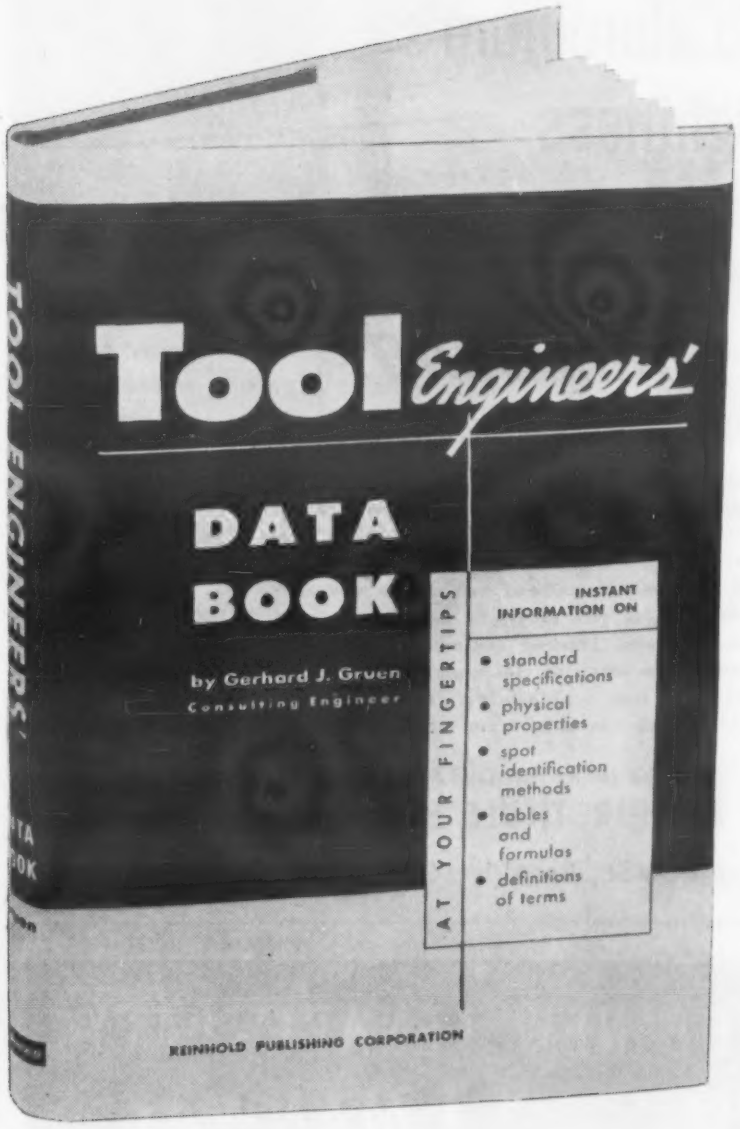

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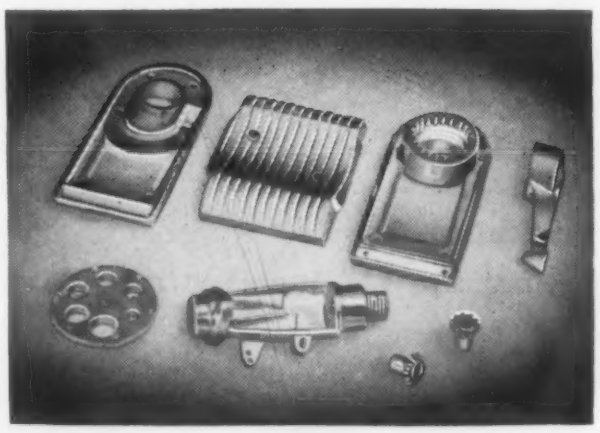

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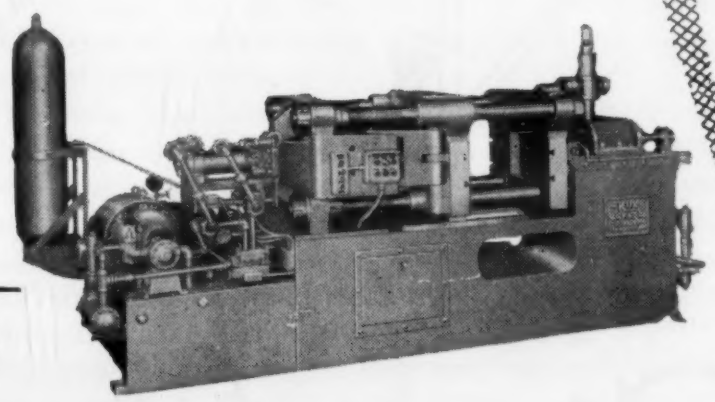

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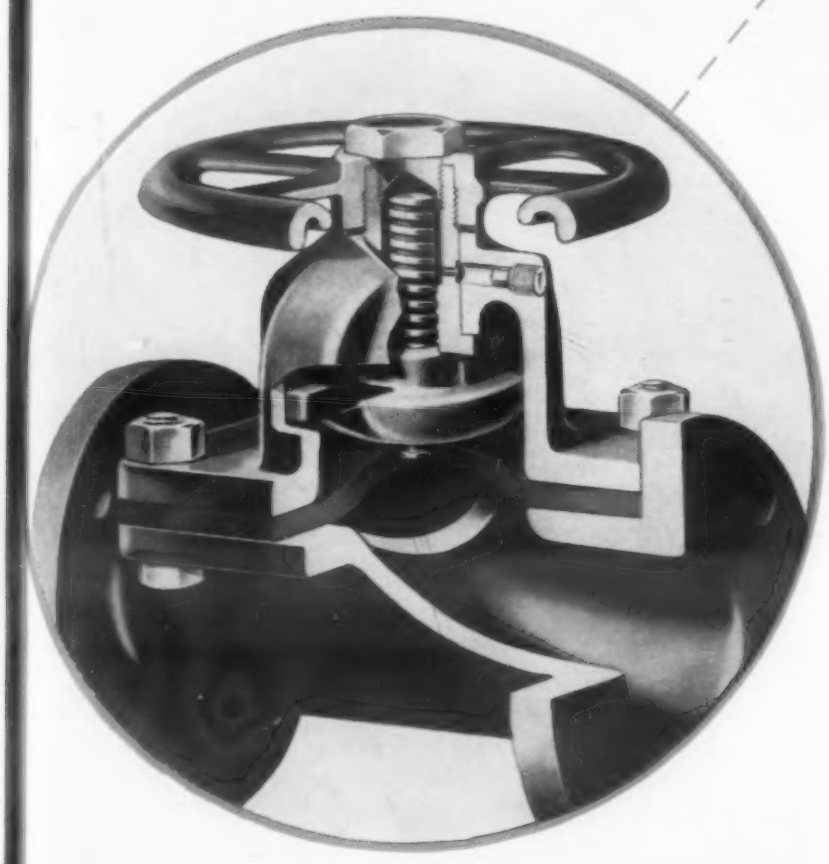
Diaphragm of Du Pont "ALATHON" cuts down-time



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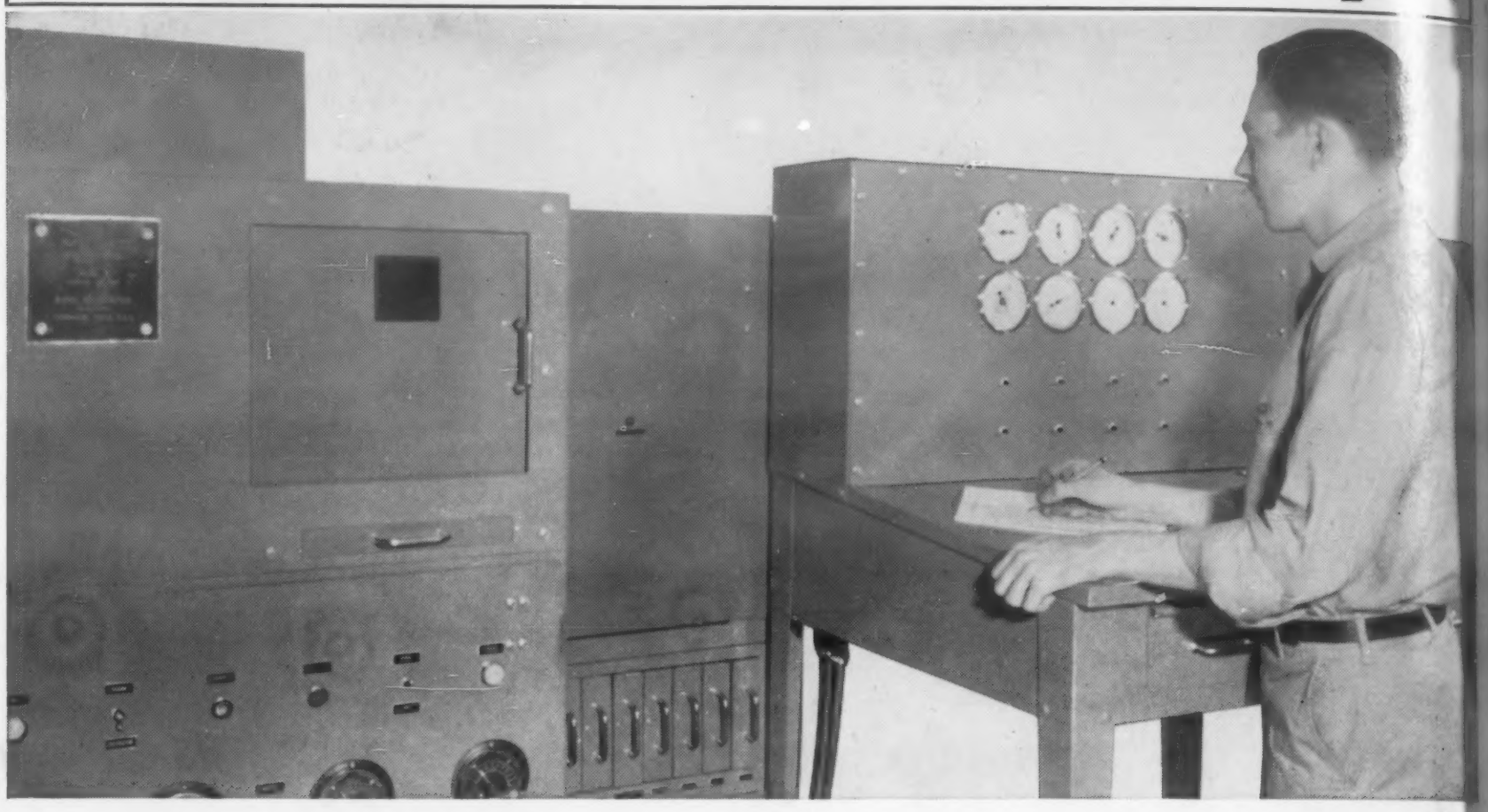

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